DRAFT ENVIRONMENTAL IMPACT STATEMENT/
ENVIRONMENTAL IMPACT REPORT

State Clearinghouse No. 95052023

Eagle Mountain Landfill and Recycling Center Project

Technical Appendices Volume II

County of Riverside Planning Department

and

United States Department of the Interior
Bureau of Land Management

Prepared by:
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July 1996

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Appendix F
Updated Hydrology Report

ADDENDUM TO
EAGLE MOUNTAIN PROJECT
DRAINAGE REPORT

NOVEMBER 1991
REVISED JANUARY 1996

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SCOPE

The purpose of this Addendum to the hydrology study is in response to a Riverside County Flood Control and Water Conservation District letter dated June 4, 1992. This Addendum does not alter the intent of the scope of the original study.

BASE CRITERIA

The text of the fourth paragraph is revised as Precipitation values were provided by Riverside County Flood Control District and Water Conservation District in a letter dated June 4, 1992.

Frequent (yrs.)	1 Hour Depth (Inches)	3 Hour Depth (Inches)	6 Hours Depth (Inches	24 Hour Depth (Inches)
100	1.77	2.47	2.76	3.68

EXISTING CONDITIONS

The storm flow in paragraph numbered one is amended as follows:

1. Pre-Mining Condition

Prior to development of Kaiser Steel mining operations, two main watercourses, Eagle Creed and Bald Eagle Creek flowed through the study site. Eagle Creek drains west to east with a tributary of 4,620 acres. Bald Eagle Creek drains north to south with a tributary of 1,210 acres. Both confluenced at a point which is not the Eagle Mountain town site, conveying a 100 year, 3 hour peak flow of ***6006*** cfs. Runoff from the confluence spread into sheet flow and discharged southeasterly over a wide alluvial fan.

The flows in the second, fourth and fifth paragraphs are amended as follows:

2. Post-Mining Condition

In order to prevent flooding of the townsite and adjacent processing area, Eagle Creek was blocked in two places creating drainage retention areas. During heavy storms, this situation allows Eagle Creek to pond and spill over the main haul road, directing flows into the west bowl of the East Pit. A 100 year - 3 hour peak flow of ***5704*** cfs from the two major tributaries would be retained within the west bowl of the East Pit whose volume is more than adequate to contain the total flow. The east bowl of the East Pit collects a 100 year-3 hour peak flow of ***1343*** cfs from a tributary of 774 acres.

Runoff from the previous mining operations area and the adjacent hillside does not enter the East Pit. An earthen channel, draining west to east through the operations area, collects drainage from these areas generating a peak flow of ***358*** cfs. This drainage is routed into another channel parallel and north the Kaiser Road. The Kaiser Road channel directs flows away from the town site and discharges into the desert towards the southeast. Earthen berms have ben constructed parallel to Kaiser Road which provide additional protection to the townsite.

West of the town site and the Return to Custody facility, a large tributary area of approximately 431 acres generates a flow of ***681*** cfs. This flow is directed under the existing railroad tracks through a 96-inch diameter pipe. Discharge is easterly and south of the town site. Due to prior flood damage to the railroad facilities in this area, additional drainage facilities will need to be incorporated into the rail repair.

INTERIM CONDITION

The storm flow is amended as follows:

1. Stage 1 Drainage

Bald Eagle Creek will continue to discharge directly into the west bowl of the East Pit. Eagle Creek will be piped under the haul road from the existing lower retention area upstream of the Eagle Mountain townsite to a graded trapezoidal channel along the northern edge of the roadway. The upper existing retention basin will be opened so that runoff will continue to flow towards the lower retention area. Spill over onto the roadway will not occur as in the existing condition. The side walls of the channel will be rip-rap. Rock cut-off walls will be placed as necessary where velocities are erosive. A 100 year-3 hour peak flow of ***5704*** cfs will discharge into the west bowl of the East Pit. Stage 1 drainage will be in effect during landfill Phases 1A and 1B, approximately 15 years.

The storm flow is amended as follows:

2. Stage 2 Drainage

A perimeter channel will be constructed to intercept Bald Eagle Creek. Runoff will be routed along the northern edge of the landfill footprint and discharged into a natural watercourse. The channel construed in Stage 1 will be extended to the east, bypassing the west bowl and discharging into the east bowl of the East Pit. The east bowl will collect the diverted peak flow as well as runoff naturally draining into the east bowl, a 100 year-3 hour peak flow of ***6857*** cfs.

Storm Flows are amended as follows:

1. <u>Eagle Creek Drainage</u>

Eagle Creek and it's 4,310 acre tributary drains west to east towards Planning Area No. 2 generating a 100 year peak flow of ***6006*** cfs. The two retention facilities upstream of Planning Area No. 2 created by the mining operation will be utilized. Both of these retention facilities will be modified into flow-by detention facilities in order to mitigate peak flows. These facilities will reduce the 100 year peak flow draining into Planning Area No. 2 to ***2069*** cfs. This mitigated peak flow will be conveyed by the graded channel developed for the interim stage and routed north of Planning Area No. 2. A trapezoidal channel incorporating rip-rap side walls and rock cut-off walls will direct the drainage south into and the along the western edge of a flow-by detention basin located in the southwest corner of Planning Area No. 5. A peak flow of ***681*** cfs from a 461 acre tributary area being collected by perimeter drains of the landfill will be rerouted into this same channel and into the flow-by basin addressed above. Peak flows will be detained by the basin while lower volume flows are conveyed int he adjacent bypass channel. A second detention basin will directly follow the previous basin in order to further mitigate peak flows. This dual-detention basin system will reduce the 100 year peak flow in the channel to 1,529 cfs. The channel will route the drainage along the southern border of Planning Area No. 5 and Planning Area No. 4. Planning Area No. 5 is comprised of fine tailing basins which contain their own runoff. Therefore, no additional acreage drains into the storm channel from this area. One the supply of fine tailings is exhausted, these areas may be considered as possible drainage detention facilities. Planning Area No. 4 is also comprised of two large basins which contain their own runoff. The southern basin will be considered as a possible flow-by detention facility which will discharge into the channel. This mitigation facility reduces the peak flow to 469 cfs which will be carried under the railroad by a box culvert and then discharged onto an energy dissipating structure designed to reduce velocities at the crossing of the MWD Aqueduct to a non-erosive nature.

Storm flows are amended as follows:

2. <u>Planning Area No. 2</u>

Paragraph 1 changed to read:
Currently a tributary area of 83 acres drains directly onto the operational facilities of Planning Area No. 2 from the adjacent hillside generating a peak 100 year-3 hour flow of ***441*** cfs. In order to prevent natural runoff from contacting landfill operations, this drainage will be collected and conveyed by a trapezoidal graded channel parallel to the roadway bordering the southern edge of the operations facility. Drainage will be collected from the channel by a drop inlet and carried under the railroad by a 54" pipe culvert. Runoff will be discharged into an existing storm channel north of the Eagle Mountain town site.

Paragraph 3 changed to read:
Runoff from the operational facilities in Planning Area No. 2 is comprise of 70 acres generating a peak 100 year-3 hour flow of ***283*** cfs...

Storm flows revised and Paragraph 1 changed to read:

3. Planning Area No. 3

Planning Area No. 3 will incorporate two main drainage courses flowing towards the railroad facilities. The southern watercourse has a tributary of 430 acres and generates a 100 year-3 hour peak flow of ***586*** cfs. This drainage is conveyed in a graded channel bordering the southern edge of Planning Area No. 3 to the railroad facility. The northern tributary of 311 acres generates a 100 year-3 hour peak flow of ***517*** cfs. A graded channel along the western edge of the railroad facility will collect the runoff and convey the drainage to a point near the center of the railroad yard. Drainage for both streams will be conveyed under the railroad by one or more box culverts toward energy dissipating structures. These structures will slow velocities to a non-erosive nature before crossing the MWD Aqueduct.

CONCLUSION

Storm flows revised to read:

The ultimate hydrology plan is to re-instate the pre-mining condition watercourses when possible The development of the Kaiser Steel Mining operation, especially the creation of the east mining pit, has established a total retention situation for Eagle Creek ad Bald Eagle Creek. Downstream facilities have not had to be concerned with the drainage of Eagle Creek and Bald Eagle Creek since 1975. In filling the East Pit, through development of the Eagle Mountain Landfill Project, drainage will once again become a concern. Development of the Eagle Mountain town site prevents discharge of Eagle Creek to its original location and development of the landfill prevents discharge of Bald Eagle Creek at its original location. In redirecting these major water courses, peak flows and velocities will be mitigated to less than the pre-mining condition at discharge points. The routing of Eagle Creek generates a 100 year - 3 hour peak flow of ***4571*** cfs. After mitigation, the possible 100 year-3 hour peak flow will be 469 cfs, a reduction of ***89 %***. Redirection of Bald Eagle Creek generates a 100 year-3 hour peak flow of ***2018*** cfs. After mitigation at the discharge point the peak flow will be ***1027*** cfs in the pre-mining condition, a reduction in peak flow will occur due to the Eagle Mountain Landfill Project.

Two main tributaries cross Planning Area No. 3. In the pre-mining condition, the western tributary generated a 100 year-3 hour peak flow of ***810*** cfs. The ultimate landfill development reduces this flow to ***517*** cfs, a reduction of 36%. The southern tributary incorporates a reduction of 14%, a pre-mining peak flow of ***683*** cfs as compared to ***586*** cfs in the landfill developed condition.

In all cases a reduction in peak flow has occurred. The following charts illustrate peak flow characteristics in various stages of landfill development at key locations:

Drainage Location	Existing Condition		Developed Condition		
	Pre-Mining	Post-Mining	Stage 1	Stage 2	Ultimate
Discharging into West Bowl of East Pit	N/A	5704 cfs	5655 cfs	0 cfs	N/A
Discharging into East Bowl of East Pit	N/A	1343 cfs	1343 cfs	6857 cfs	N/A
Existing Planning Area No. 2 Operational Facilities					
a. Eagle Creek/Bald Eagle Creek	6006 cfs	358 cfs	0 cfs	0 cfs	0 cfs
b. Site Drainage	N/A	358 cfs	730 cfs	730 cfs	730 cfs
1. collected	N/A	N/A	283 cfs	283 cfs	283 cfs
2. diverted	N/A	N/A	447 cfs	447 cfs	447 cfs
Draining into Location of Eagle Mountain Town Site					
a. Eagle Creek/Bald Eagle Creek	6006 cfs	358 cfs	0 cfs	0 cfs	0 cfs
b. Hills West of Townsite	681 cfs	681 cfs	681 cfs	681 cfs	681 cfs
Existing Planning Area No. 3					
a. Northern Tributary	810 cfs	181 cfs	181 cfs	181 cfs	517 cfs
b. Southern Tributary	683 cfs	253 cfs	253 cfs	253 cfs	586 cfs

100 YEAR, 3 HOUR PEAK FLOWS DRAINING OFFSITE						
Drainage Course	Existing Condition		Ultimate Developed Condition		Future Outlet Point	
	Pre-Mining	Post-Mining	Non-Mitigated Flow	Possible Mitigated Flow	Pre-Mining	Post-Mining
Eagle Creek	4536 cfs	358 cfs	4571 cfs	469 cfs	358 cfs	358 cfs
Bald Eagle Creek	1693 cfs	0 cfs	2018 cfs	1027 cfs	1366 cfs	380 cfs
Planning Area No. 3						
Northern Tributary	810 cfs	181 cfs	517 cfs	517 cfs	810 cfs	181 cfs
Southern Tributary	683 cfs	253 cfs	586 cfs	586 cfs	683 cfs	253 cfs

DETENTION BASIN MITIGATION				
Basin	**Location**	**Total Storage Capacity**	**100 year, 3 hour Flow Entering Basin**	**100 year, 3 hour Flow Exiting Basin**
A	West of Planning Area No. 2	91 Ac. Ft.	4204 cfs	2436 cfs
B	West of Planning Area No. 2	88 Ac. Ft.	3079 cfs	2069 cfs
E, F	South West Corner of Planning Area No. 5	140 Ac. Ft 50 Ac. Ft	2056 cfs	1529 cfs
G	Planning Area No. 4	352 Ac. Ft.	1529 cfs	469 cfs
H	North East Corner of Planning Area No. 6	60 Ac. Ft.	2018 cfs	1027 cfs

EAGLE MOUNTAIN
PROJECT

DRAINAGE REPORT

NOVEMBER 1991

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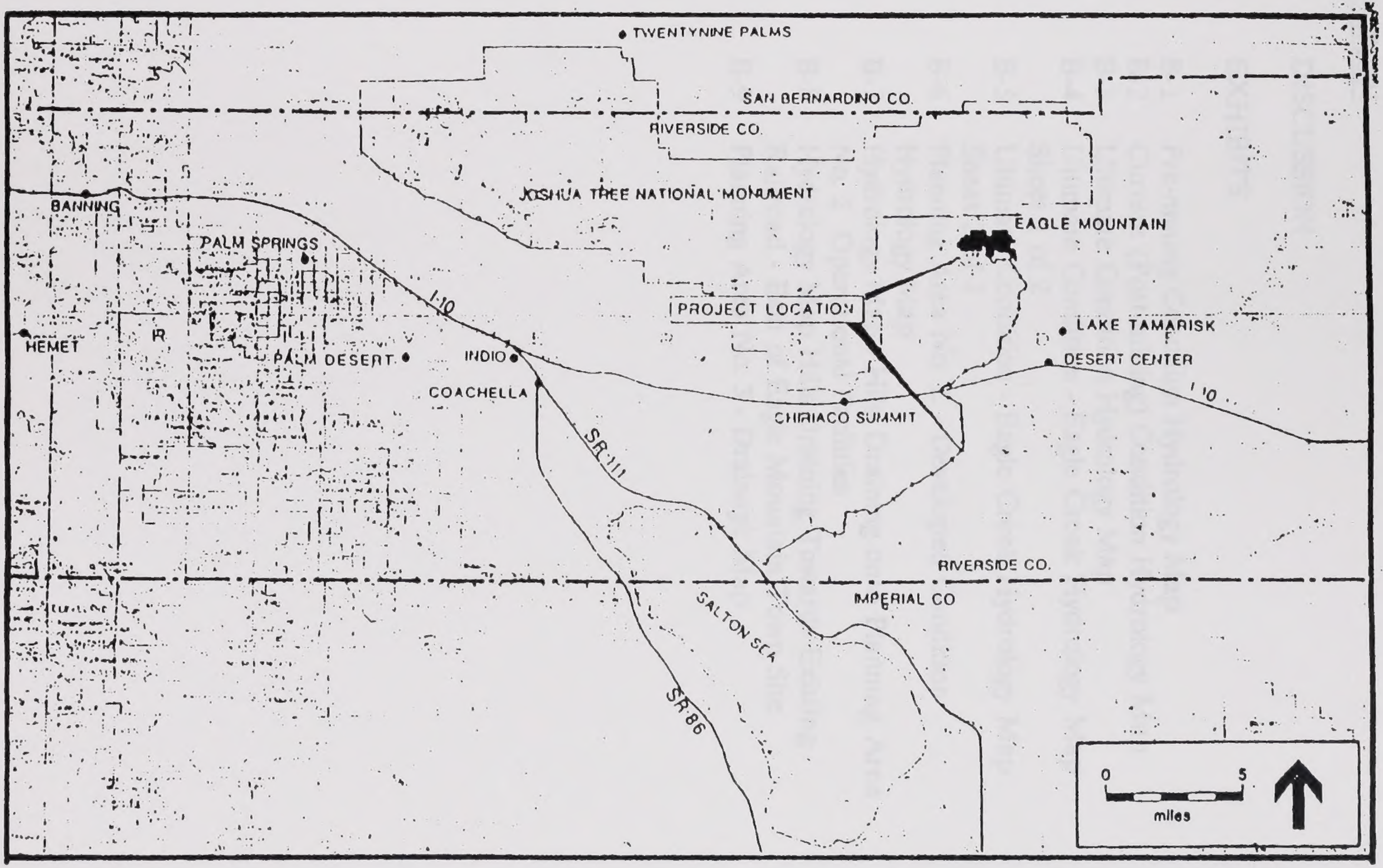

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SECTION A

DISCUSSION

EAGLE MOUNTAIN LANDFILL PROJECT
DRAINAGE REPORT

GENERAL OVERVIEW

This hydrology study evaluates the ultimate and interim drainage plans associated with development of the Eagle Mountain Landfill Project. Two main tributaries, Eagle Creek and Bald Eagle Creek are the main sources of runoff to the study site. Currently, both tributaries drain into the East Mining Pit which acts as a total retention basin. With development of the proposed landfill, these watercourses will be routed away from the landfill site and operational facilities. Ultimate drainage will be returned to pre-mining conditions where possible. Eagle Creek will be routed through channels and a series of detention facilities in order to mitigate peak flows. Bald Eagle Creek will be intercepted and routed around the landfill site to a detention facility sized to mitigate flows to pre-mining conditions.

In accordance with the Federal Clean Water Act (Section 402(p)), storm water discharges associated with industrial activity must meet all applicable provisions of the National Pollutant Discharge Elimination System (NPDES). This program requires the testing, treatment and monitoring of storm water discharges which may contain hazardous substances in excess of established criteria. As part of the permitting process, an NPDES permit application will be filed with the Regional Water Quality Control Board.

Surface runoff from container handling facilities, equipment washing areas, maintenance facilities and other operational areas will be collected and routed by concrete lined channels to a settling tank and then to a wastewater pre-treatment facility. Floating oil, grease, sand, sludge and other materials will be removed prior to reuse or release into the storm channels. All wastewater will be tested in accordance with procedures and criteria established by Riverside County. Only non-polluted waters will be released into natural drainage courses. Waters found to be unsuitable for discharge will be collected and trucked to off-site licensed facilities for disposal.

SCOPE

The purpose of this hydrology study is to compare the existing and pre-mining conditions with the ultimate developed condition 100-year peak runoff volumes associated with the Eagle Mountain Landfill Project Drainage Plan.

SITE LOCATION

The Eagle Mountain Landfill Project is located in the Eagle Mountain Range, eleven miles north of Desert Center and the Interstate 10 Freeway. The site is accessed by Eagle Mountain Road and Kaiser Road. Just south of the study site is the Eagle Mountain town site. The Metropolitan Water District (MWD) Colorado River Aqueduct borders the site to the east.

BASE CRITERIA

The drainage concept of this plan is based on the premise that natural storm water runoff should not come in contact with landfill operations, so as to avoid possible contamination of "clean" water. Designs incorporate down stream concerns such as Kaiser Road, Eagle Mountain Road, Eagle Mountain railroad, the Eagle Mountain town site, the MWD Aqueduct, and downstream properties in such a manner as to minimize adverse effects to these facilities due to the routing of storm waters.

Hydrology is based on the current Riverside County Flood Control District Hydrology Manual, dated April, 1978. The CivilCadd Rational Method (Version 2.6), Unit Hydrograph and Hydrograph Routing Programs for Riverside County are also utilized in this study. Drainage and flood control facilities will be designed in accordance with the requirements of the September 1984 Memorandum of Understanding between Riverside County and Riverside County Flood Control and Water Conservation District. Although the study site is not located within the boundaries of the Riverside County Flood Control District, the District will review and approve the drainage plan for Riverside County. Maintenance of all drainage facilities will be the responsibility of the operators of the landfill.

Proposed drainage improvements for the landfill will comply with regulations implemented by the Colorado River Basin Region of the California Regional Water Quality Control Board (RWQCB).

Data and procedures for the generation of precipitation values have been obtained from the NOAA Atlas 2 - Volume XI - California (Precipitation Frequency Atlas of the Western United States) dated 1973:

Frequent (Yrs.)	1 Hour Depth (Inches)	3 Hour Depth (Inches)	6 Hours Depth (Inches)	24 Hour Depth (Inches)
100	1.56	2.08	2.55	4.15

Article 2546, Subchapter 15, Title 23 of the California Administration Code requires drainage facilities within the waste management unit be sized to handle a 100 year - 24 hour storm. This includes channels on the landfill and within the working face of the landfill. Riverside County Flood Control District recommends sizing drainage facilities outside of the landfill footprint, including landfill perimeter channels, to handle a short-term, high intensity, 100 year-3 hour storm. The 24 hour storm generates a higher total volume of runoff and a lower peak flow (cfs) over a longer period of time. The 3 hour storm, typical of the area, generates approximately twice the peak flow and less volume over a shorter period of time. A drainage channel sized for the 3 hour storm is more than adequate to handle the 24 hour storm. Therefore, sizing permanent drainage facilities to handle the 3 hour storm establishes a more conservative system with a greater level of protection from storm waters.

Drainage channels will be graded and trapezoidal in shape, incorporating channel protection measures where velocities are of an erosive nature. Channels collecting drainage from operations and container handling facilities will be concrete lined where necessary to minimize percolation. Sizing of permanent drainage channels is based on a 100 year - 3 hour storm and incorporates a 20% bulking factor as well as 2 feet of freeboard.

Soil Type D and a Mannings value of 0.045 have been used in this study based on the high runoff potential due to steep canyons and rocky texture of the soil. These conditions provide a runoff coefficient of 93 for natural areas and 98 for paved areas.

EXISTING CONDITIONS

The terrain of the watercourse tributaries outside of the study site can be described as undeveloped, rocky desert with little shrub cover. The steep, sharp canyons of the watercourses provide a maximum elevation of 3045 feet above sea level. A minimum elevation of 1020 is located near the MWD Aqueduct. Existing land use within the study site consists of abandon mining and processing facilities previously operated by Kaiser Steel Corporation. Most of the above ground processing structures have been removed. Remaining facilities consist of unpaved roads, a few buildings and structures, foundations, railroad tracks and minor drainage facilities. Very little impervious areas exist within the study site. Existing conditions are comprised of two separate components, current existing conditions due to processing and mining operations and pre-mining conditions.

1. Pre-Mining Condition

Prior to development of Kaiser Steel mining operations, two main watercourses, Eagle Creek and Bald Eagle Creek flowed through the study site. Eagle Creek drains west to east with a tributary of 4,620 acres. Bald Eagle Creek drains north to south with a tributary of 1,210 acres. Both confluenced at a point which is now the Eagle Mountain town site, conveying a 100 year, 3 hour peak flow of 4,967 cfs. Runoff from the confluence spread into sheet flow and discharged southeasterly over a wide alluvial fan.

2. Post-Mining Condition

Development of the Eagle Mountain site by Kaiser Steel Corporation for the mining and processing of iron ore effected changes to the previous natural drainage courses. Mining excavation of the East Pit directly intercepted Bald

Eagle Creek. This tributary currently discharges directly into the west bowl of the East Pit.

In order to prevent flooding of the townsite and adjacent processing area, Eagle Creek was blocked in two places creating drainage retention areas. During heavy storms, this situation allows Eagle Creek to pond and spill over the main haul road, directing flows into the west bowl of the East Pit. A 100 year - 3 hour peakflow of 4,729 cfs from the two major tributaries would be retained within the west bowl of the East Pit whose volume is more than adequate to contain the total flow. The east bowl of the East Pit collects a 100 year-3 hour peak flow of 1,120 cfs from a tributary of 774 acres.

Basins for the collection of fine tailings were created as part of the mining operations. Located southeast of the East Pit, these act as individual retention basins which retain rain falling directly on them. Therefore, no runoff is generated from these areas.

Runoff from the previous mining operations area and the adjacent hillside does not enter the East Pit. An earthen channel, draining west to east through the operations area, collects drainage from these areas generating a peak flow of 298 cfs. This drainage is routed into another channel parallel and north of Kaiser Road. The Kaiser Road channel directs flows away from the town site and discharges into the desert towards the southeast. Earthen berms have also been constructed parallel to Kaiser Road which provide additional protection to the townsite.

West of the town site and the Return to Custody facility, a large tributary area of approximately 431 acres generates a flow of 567 cfs. This flow is directed under the existing railroad tracks through a 96-inch diamter pipe. Discharge is easterly and south of the town site. Due to prior flood damage to the railroad facilities in this area, additional drainage facilities will need to be incorporated into the rail repair.

INTERIM CONDITION

During the initial phases of the proposed landfill operation, drainage from Eagle Creek and Bald Eagle Creek will be handled in several stages.

1. Stage 1 Drainage

Bald Eagle Creek will continue to discharge directly into the west bowl of the East Pit. Eagle Creek will be piped under the haul road from the existing lower retention area upstream of the Eagle Mountain townsite to a graded trapezoidal channel along the northern edge of the roadway. The upper existing retention basin will be opened so that runoff will continue to flow towards the lower retention area. Spillover onto the roadway will not occur as in the existing condition. The side walls of the channel will be rip-rap. Rock cut-off walls will be placed as necessary where velocities are erosive. A 100 year-3 hour peak flow of 4,729 cfs will discharge into the west bowl of the East Pit. Stage 1 drainage will be in effect during landfill Phases 1A and 1B, approximately 15 years.

2. Stage 2 Drainage

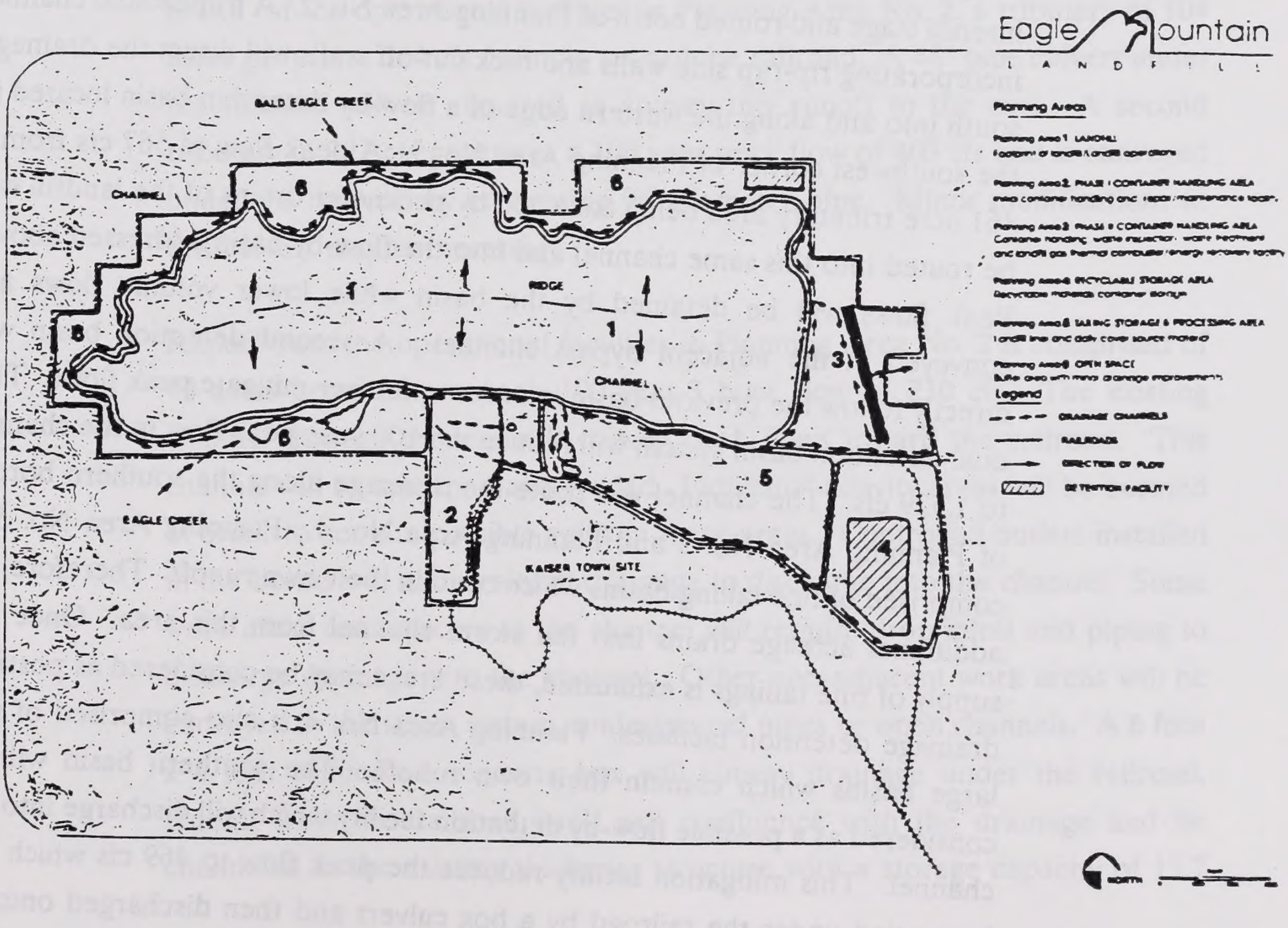
A perimeter channel will be constructed to intercept Bald Eagle Creek. Runoff will be routed along the northern edge of the landfill footprint and discharged into a natural watercourse. The channel constructed in Stage 1 will be extended to the east, bypassing the west bowl and discharging into the east bowl of the East Pit. The east bowl will collect the diverted peak flow as well as runoff naturally draining into the east bowl, a 100 year-3 hour peak flow of 5,689 cfs.

3. Landfill Working Face Drainage

When landfill operations begin in an area, a temporary drainage ditch will be established around the up slope perimeter to intercept stormwater runoff and route it around the active, or working area. As each area is filled, it will be

covered with a low permeability compacted soil cap. Final grading of the capped areas will consist of 2:1 (horizontal to vertical) side slopes with an 8-foot wide bench at each 25-foot height increment and a 25-foot wide bench at each 100-foot height increment. Each of these benches will have a v-ditch running along its length to intercept runoff. The top of each fill cap area, whether at interim or final grade, will form a plateau and be graded to drain to the uppermost bench. The bench drains, in turn, will empty into either larger v-ditches or drop into pipe systems along the outer edges of the fill area. These perimeter ditches or pipes will be sized to carry runoff from the graded fill slope areas and convey these flows to either the Eagle Creek channel, to the south, or to the Bald Eagle Canyon perimeter ditch, along the northern edge of the land fill footprint. Final landfill grading will be designed in accordance with Riverside County Grading Ordinances.

DEVELOPED CONDITION



The developed condition hydrology is based on the ultimate drainage plan for the Eagle Mountain Landfill Project. Land use in Planning Areas No. 2 and No. 3 can be considered industrial. However, offsite tributary areas will remain as undeveloped, rocky desert area.

1. Eagle Creek Drainage

Eagle Creek and it's 4,310 acre tributary drains west to east towards Planning Area No. 2 generating a 100 year peak flow of 3,611 cfs. The two retention facilities upstream of Planning Area No. 2 created by the mining operation will be utilized. Both of these retention facilities will be modified into flow-by detention facilities in order to mitigate peak flows. These facilities will reduce the 100 year peak flow draining into Planning Area No. 2 to 2,362 cfs. This mitigated peak flow will be conveyed by the graded channel developed for the interim stage and routed north of Planning Area No. 2. A trapezoidal channel incorporating rip-rap side walls and rock cut-off walls will direct the drainage south into and along the western edge of a flow-by detention basin located ir the southwest corner of Planning Area No. 5. A peak flow of 567 cfs from a 461 acre tributary area being collected by perimeter drains of the landfill wil be routed into this same channel and into the flow-by basin addressed above Peak flows will be detained by the basin while lower volume flows are conveyed in the adjacent bypass channel. A second detention basin wil directly follow the previous basin in order to further mitigate peak flows. Thi dual-detention basin system will reduce the 100 year peak flow in the channe to 1,529 cfs. The channel will route the drainage along the southern borde of Planning Area No. 5 and Planning Area No. 4. Planning Area No. 5 i comprised of fine tailing basins which contain their own runoff. Therefore, n additional acreage drains into the storm channel from this area. Once th supply of fine tailings is exhausted, these areas may be considered as possibl drainage detention facilities. Planning Area No. 4 is also comprised of tw large basins which contain their own runoff. The southern basin will b considered as a possible flow-by detention facility which will discharge into th channel. This mitigation facility reduces the peak flow to 469 cfs which wi be carried under the railroad by a box culvert and then discharged onto a

energy dissipating structure designed to reduce velocities at the crossing of the MWD Aqueduct to a non-erosive nature.

2. Planning Area No. 2

Currently, a tributary area of 83 acres drains directly onto the operational facilities of Planning Area No. 2 from the adjacent hillside generating a peak 100 year-3 hour flow of 308 cfs. In order to prevent natural runoff from contacting landfill operations, this drainage will be collected and conveyed by a trapezoidal graded channel parallel to the roadway bordering the southern edge of the operations facility. Drainage will be collected from the channel by a drop inlet and carried under the railroad by a 54" pipe culvert. Runoff will be discharged into an existing storm channel north of the Eagle Mountain town site.

South of the operational facilities in Planning Area No. 2, a tributary of 104 acres generates 164 cfs draining toward the railroad. A 48" pipe culvert under the railroad will be required to convey this runoff to the east. A second tributary of 327 cfs generates a 100 year peak flow of 403 cfs and is conveyed under the railroad by an existing 96" diameter pipe. Minor modifications to this culvert may be necessary.

Runoff from the operational facilities in Planning Area No. 2 is comprised of 70 acres generating a peak 100 year-3 hour flow of 230 cfs. The existing channel through the site will convey peak flows toward the railroad. This channel will be reshaped and graded. Individual activity areas will be bermed in order to contain possible spills in these areas. Controlled outlets installed in the berms will allow rainfall drainage to discharge into the channel. Some work areas not adjacent to the channel will require drop inlets and piping to discharge drainage into the channel. Other non-adjacent work areas will be conveyed in the street system, underground pipes or open channels. A 6 foot x 4 foot reinforced concrete box will convey drainage under the railroad. Runoff from the railroad itself will confluence with the drainage and be channeled to the existing thickener structure with a storage capacity of 13.7

acre-feet. Drainage will be tested, treated and routed to the storm channel or treatment facility as necessary per the applicable provisions of the National Pollutant Discharge Elimination System (NPDES).

Drainage from the 40 acres east of the railroad in Planning Area No. 2 currently drain southeast to an existing storm channel. This area will continue to drain in this manner.

3. Planning Area No. 3

Planning Area No. 3 will incorporate two main drainage courses flowing towards the railroad facilities. The southern watercourse has a tributary of 430 acres and generates a 100 year-3 hour peak flow of 488 cfs. This drainage is conveyed in a graded channel bordering the southern edge of Planning Area No. 3 to the railroad facility. The northern tributary of 311 acres generates a 100 year-3 hour peak flow of 431 cfs. A graded channel along the western edge of the railroad facility will collect the runoff and convey the drainage to a point near the center of the railroad yard. Drainage for both streams will be conveyed under the railroad by one or more box culverts toward energy dissipating structures. These structures will slow velocities to a non-erosive nature before crossing the MWD Aqueduct.

Rain falling on operation facilities east of the railroad facilities in Planning Area No. 3 will be routed by concrete lined channel to a detention facility. This runoff will be tested, treated and routed to the southern storm channel or treatment facility as necessary per the applicable provisions of the National Pollutant Discharge Elimination System (NPDES).

4. Planning Area No. 1

The ultimate landfill configuration will create a series of graded hillsides with a ridge line running east to west. Drainage channels will perimeter the landfill and collect landfill runoff. A high point created by the landfill, located to the northwest, will determine direction of flow in the perimeter channels.

Channels will be graded and trapezoidal in shape utilizing protective measures where velocities are of an erosive nature.

Rain falling south of the ridge line will be collected by the southern perimeter channel. A total of 1487 acres will drain south toward three separate outlets. The first outlet will drain into the detention basin in Planning Area No. 5. The second point of discharge will drain into the southern channel of Planning Area No. 3 and the third outlet will discharge into the northern channel of Planning Area No. 3. These acreages will be included in the downstream conveyance calculations.

The ridge of the landfill will create a northern tributary of 1,860 acres generating 1,676 cfs. The northern perimeter channel will collect the drainage from 723 acres of landfill. This channel will also intercept runoff draining toward the landfill, including Bald Eagle Creek. The northern perimeter channel shall route this runoff to a flow-by detention basin in the northeast corner of Planning Area No. 6. The basin and channel will discharge into an existing drainage course. The existing tributary at that point generates a 100-year peak flow of 1,120 cfs in the pre-mining condition. The flow-by basin will mitigate the developed 100 year peak flow to 1,018 cfs, a runoff less than the pre-mining condition.

CONCLUSION

The ultimate hydrology plan is to re-instate the pre-mining condition watercourses when possible. The development of the Kaiser Steel Mining operation, especially the creation of the east mining pit, has established a total retention situation for Eagle Creek and Bald Eagle Creek. Downstream facilities have not had to be concerned with the drainage of Eagle Creek and Bald Eagle Creek since 1975. In filling the East Pit, through development of the Eagle Mountain Landfill Project, drainage will once again become a concern. Development of the Eagle Mountain town site prevents discharge of Eagle Creek to its original location and development of the landfill prevents discharge of Bald Eagle Creek at its original location. In redirecting these major water courses, peak flows and velocities will be mitigated to less than the

pre-mining condition at discharge points. The routing of Eagle Creek generates a 100 year - 3 hour peak flow of 3,788 cfs. After mitigation, the possible 100 year-3 hour peak flow will be 469 cfs, a reduction of 87%. Redirection of Bald Eagle Creek generates a 100 year-3 hour peak flow of 1,676 cfs. After mitigation at the discharge point the peak flow will be 1,018 cfs, a reduction of 39%. This discharge enters an existing watercourse generating 1,137 cfs in the pre-mining condition, a reduction in peak flow will occur due to the Eagle Mountain Landfill Project.

Two main tributaries cross Planning Area No. 3. In the pre-mining condition, the western tributary generated a 100 year - 3 hour peak flow of 674 cfs. The ultimate landfill development reduces this flow to 431 cfs, a reduction of 36%. The southern tributary incorporates a reduction of 14%, a pre-mining peak flow of 568 cfs as compared to 488 cfs in the landfill developed condition.

In all cases a reduction in peak flow has occurred. The following charts illustrate peak flow characteristics in various stages of landfill development at key locations:

Drainage Location	Existing Condition 100 year, 3 hour Q		Developed Condition 100 year, 3 hour Q		
	Pre-Mining	Post-Mining	Stage 1	Stage 2	Ultimate
Discharging into West Bowl of East Pit	N/A	4729 cfs	4729 cfs	0 cfs	N/A
Discharging into East Bowl of East Pit	N/A	1120 cfs	1120 cfs	5689 cfs	N/A
Exiting Planning Area No. 2 Operational Facilities					
a. Eagle Creek/Bald Eagle Creek	4967 cfs	298 cfs	0 cfs	0 cfs	0 cfs
b. Site Drainage	N/A	298 cfs	538 cfs	538 cfs	538 cfs
1. Collected	N/A	N/A	230 cfs	230 cfs	230 cfs
2. Diverted	N/A	N/A	308 cfs	308 cfs	308 cfs
Draining into Location of Eagle Mountain Town Site					
a. Eagle Creek/Bald Eagle Creek	4967 cfs	298 cfs	0 cfs	0 cfs	0 cfs
b. Hills West of Townsite	567 cfs	567 cfs	567 cfs	567 cfs	567 cfs
Exiting Planning Area No. 3					
a. Northern Tributary	674 cfs	132 cfs	132 cfs	132 cfs	431 cfs
b. Southern Tributary	568 cfs	212 cfs	212 cfs	212 cfs	488 cfs

100 YEAR, 3 HOUR PEAK FLOWS DRAINING OFFSITE						
Drainage Course	Existing Condition		Ultimate Developed Condition		Future Outlet Point	
	Pre-Mining	Post-Mining	Non-Mitigated Flow	Possible Mitigated Flow	Pre-Mining	Post-Mining
Eagle Creek	3752 cfs	298 cfs	3788 cfs	469 cfs	298 cfs	298 cfs
Bald Eagle Creek	1409 cfs	0 cfs	1676 cfs	1018 cfs	1137 cfs	317 cfs
Planning Area No. 3						
Northern Tributary	674 cfs	132 cfs	431 cfs	431 cfs	674 cfs	132 cfs
Southern Tributary	568 cfs	212 cfs	488 cfs	488 cfs	568 cfs	212 cfs

DETENTION BASIN MITIGATION				
Basin	Location	Total Storage Capacity	100 year, 3 hour Flow Entering Basin	100 year, 3 hour Flow Exiting Basin
A	West of Planning Area No. 2	50 Ac. Ft.	3493 cfs	2429 cfs
B	West of Planning Area No. 2	50 Ac. Ft.	2947 cfs	2362 cfs
E, F	South West Corner of Planning Area No. 5	102 Ac. Ft. 45 Ac. Ft.	2599 cfs	1529 cfs
G	Planning Area No. 4	346 Ac. Ft.	1527 cfs	469 cfs
H	North East Corner of Planning Area No. 6	33 Ac. Ft.	1676 cfs	1018 cfs

Reduction of velocities is also a major concern when considering the redirection of watercourses. Storm channel designs will incorporate rip-rap walls and rock cut-off walls when velocities are erosive as well as rip-rap energy dissipators at discharge points in order to protect downstream facilities and properties.

The Drainage Plan will incorporate designs which prevent natural drainage from contacting landfill operations. This concept will minimize possible contamination of drainage due to landfill operations. Drainage from landfill operational areas will be collected and tested for possible contaminants. Runoff will be treated, if necessary, and routed into storm channels per applicable provisions of the National Pollutant Discharge Elimination System (NPDES).

These concerns have been incorporated into the Eagle Mountain Drainage Plan. The Plan is designed to minimize adverse effect due to the development of the Eagle Mountain Landfill Project and to protect downstream facilities and properties while maintaining surface water quality.

(Reports\31021)

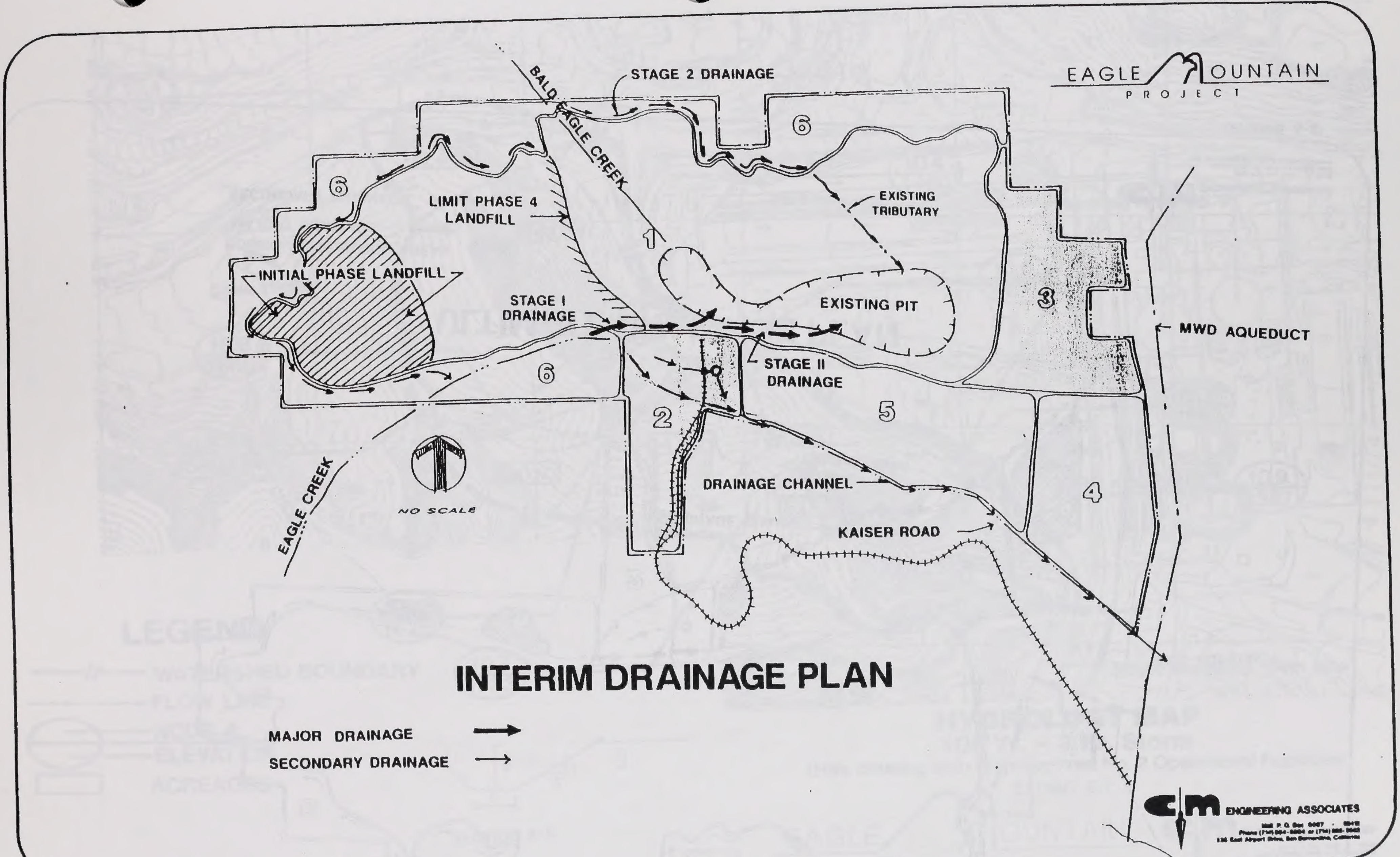

EAGLE MOUNTAIN
PROJECT
STAGE 2 DRAINAGE
BALD EAGLE CREEK
6
LIMIT PHASE 4
LANDFILL
EXISTING
TRIBUTARY
1
INITIAL PHASE LANDFILL
STAGE I
DRAINAGE
EXISTING PIT
3
MWD AQUEDUCT
STAGE II
DRAINAGE
2
5
4
EAGLE CREEK
NO SCALE
DRAINAGE CHANNEL
KAISER ROAD
INTERIM DRAINAGE PLAN
MAJOR DRAINAGE
SECONDARY DRAINAGE
CM ENGINEERING ASSOCIATES

FIGURE A-1

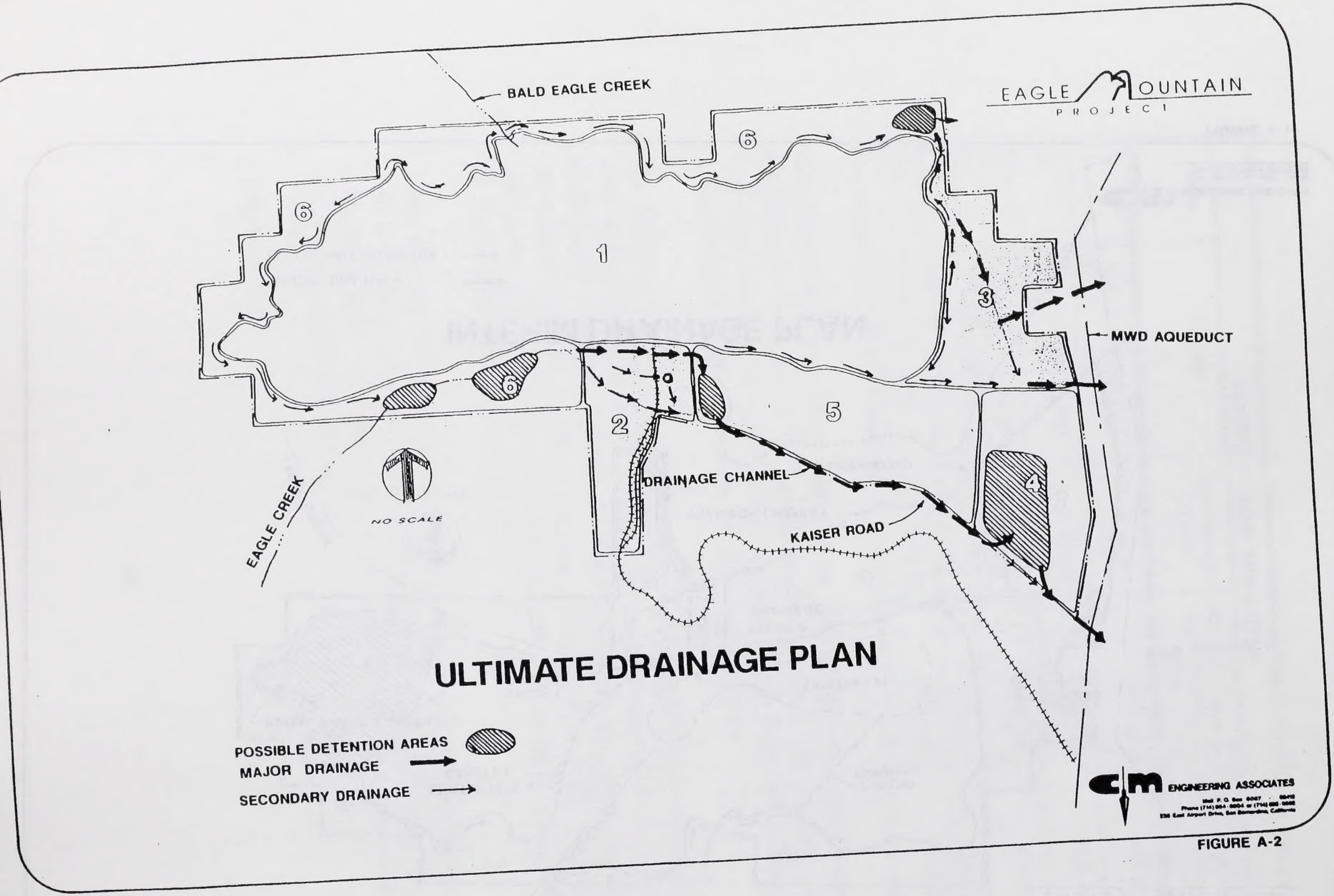
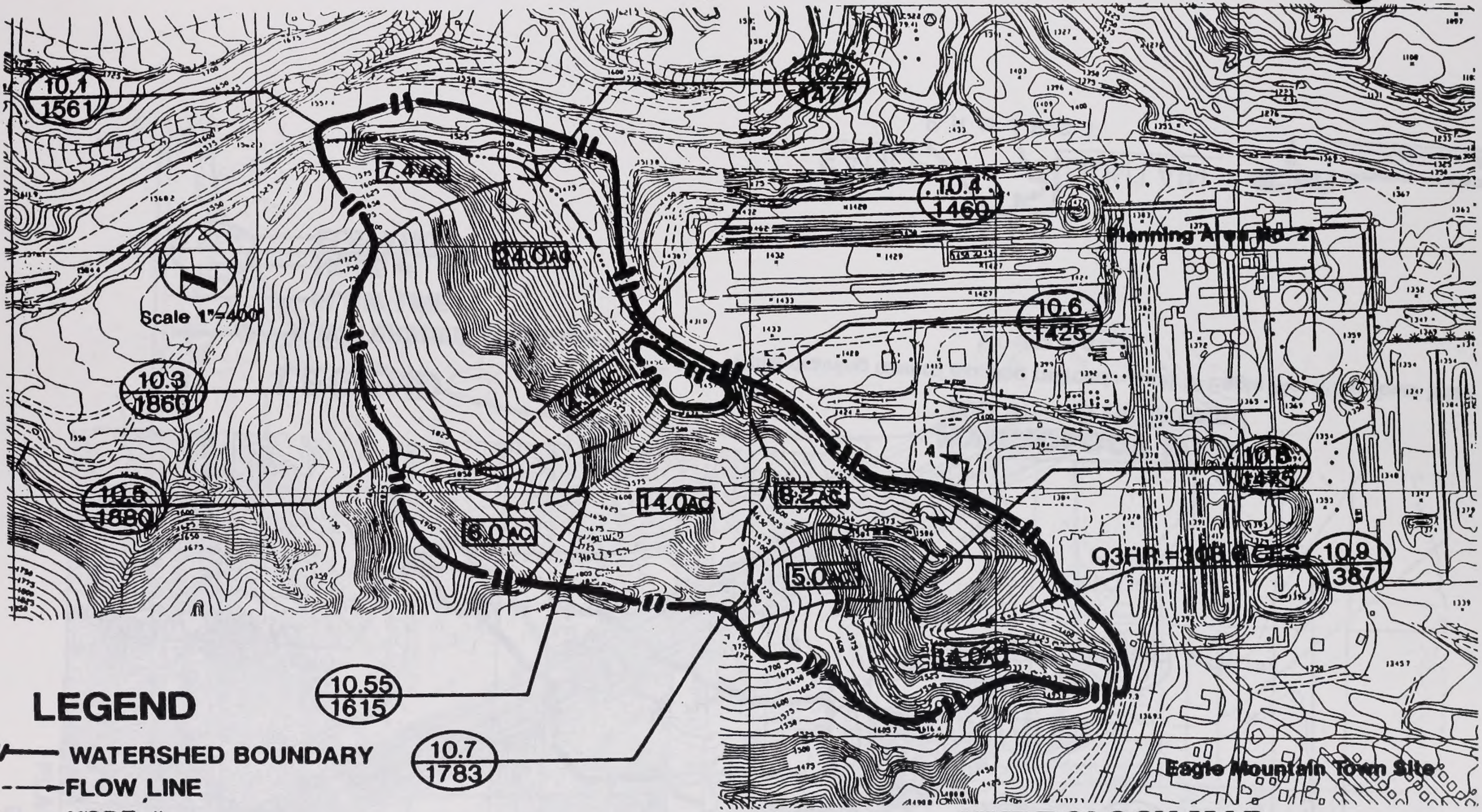
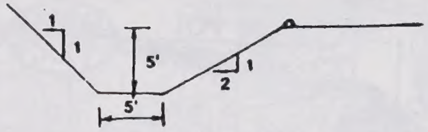

EAGLE MOUNTAIN PROJECT
BALD EAGLE CREEK
EAGLE CREEK
NO SCALE
MWD AQUEDUCT
DRAINAGE CHANNEL
KAISER ROAD
1
2
3
4
5
6
ULTIMATE DRAINAGE PLAN
POSSIBLE DETENTION AREAS
MAJOR DRAINAGE
SECONDARY DRAINAGE
CM ENGINEERING ASSOCIATES

FIGURE A-2



LEGEND

- WATERSHED BOUNDARY
- FLOW LINE
- NODE # / ELEVATION
- ACREAGES



SECTION A-A

HYDROLOGY MAP

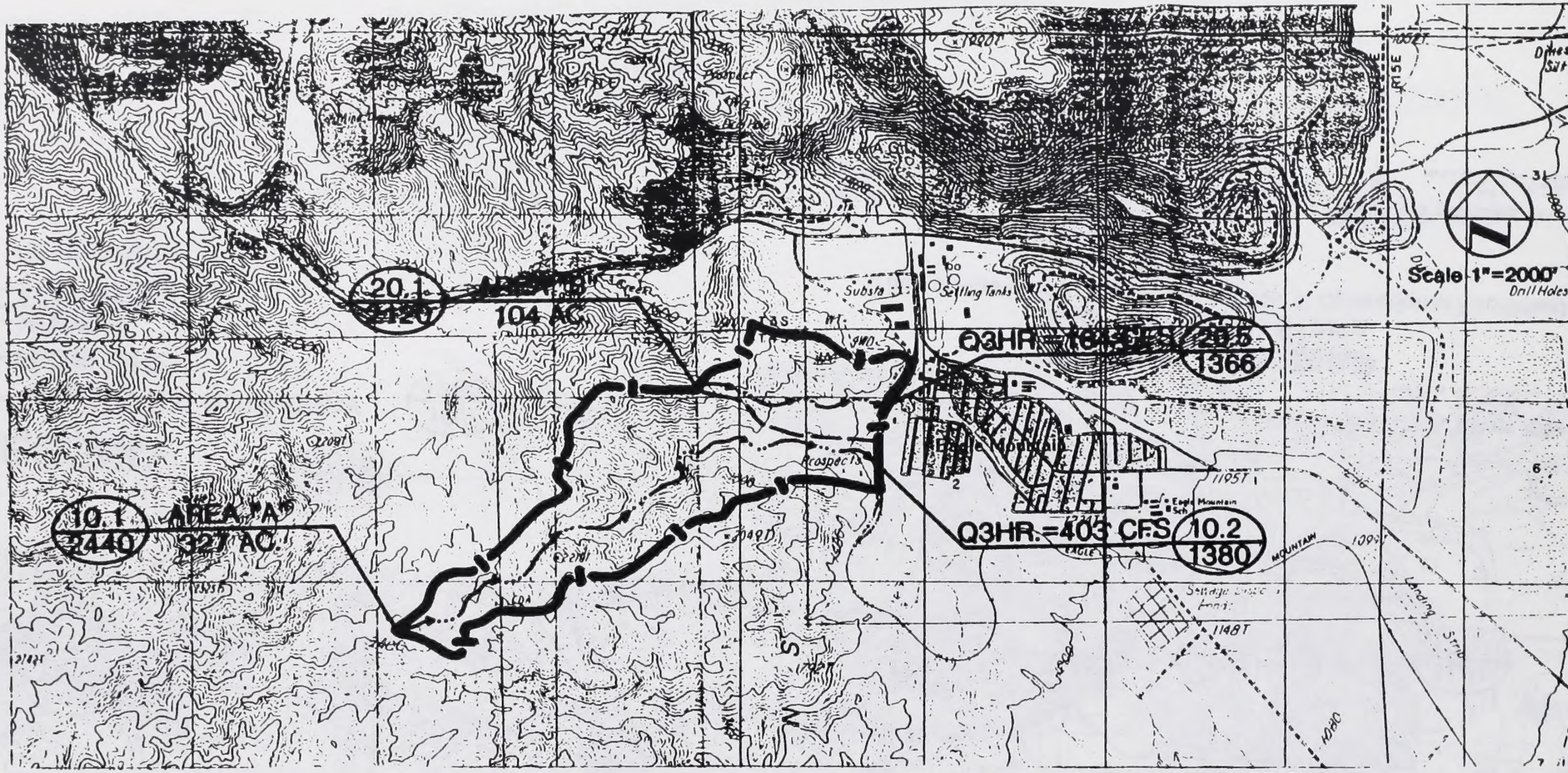
100 Yr. – 3 Hr. Storm

(Hills draining onto Planning Area No. 2 Operational Facilities)

EXHIBIT B-7

EAGLE MOUNTAIN PROJECT

CM ENGINEERING ASSOCIATES



HYDROLOGY MAP
100 Yr. – 3 Hr. Storm

(Hills draining toward existing railroad – East of Eagle Mountain Town Site)

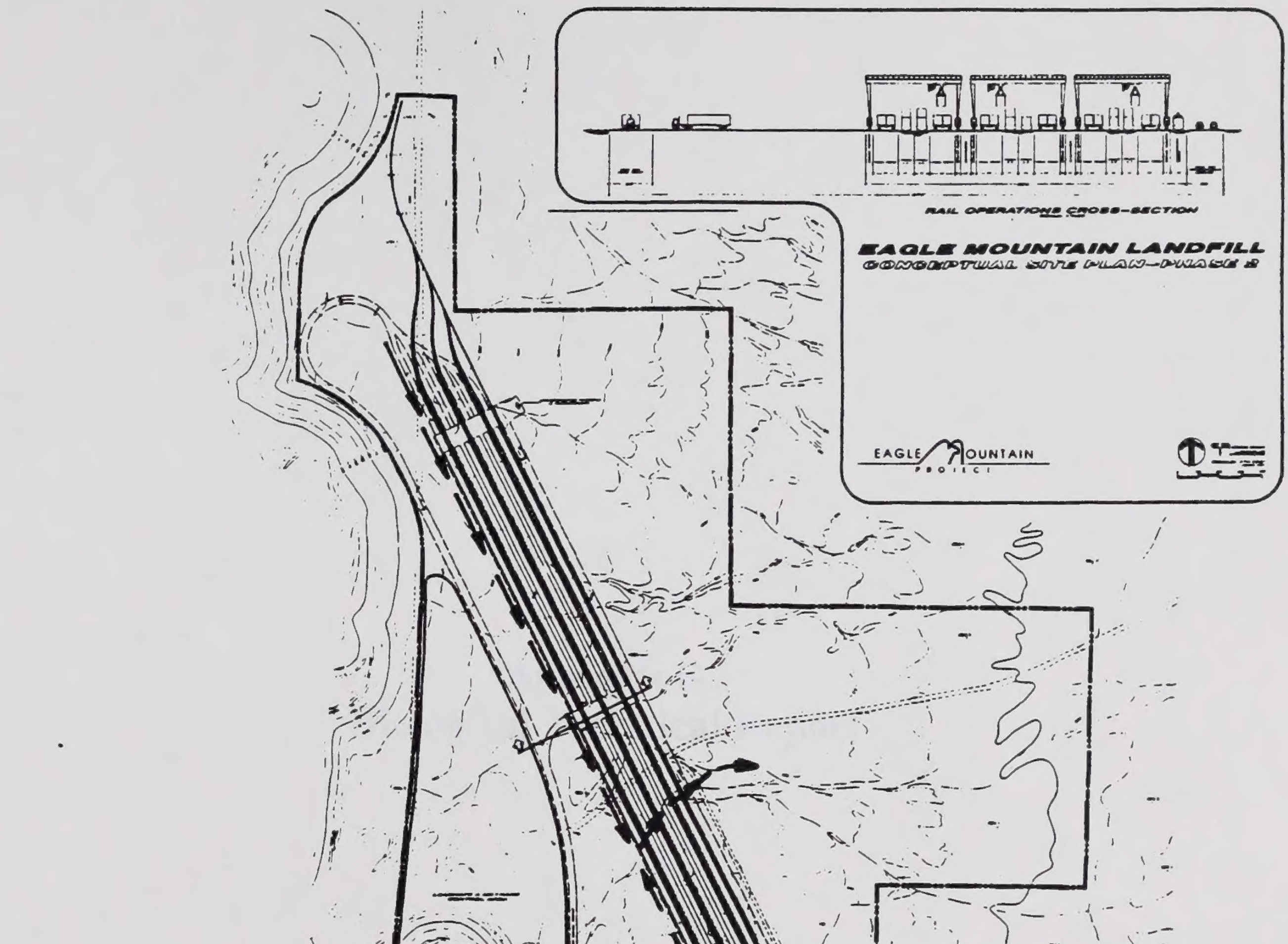
EXHIBIT B-8

LEGEND

- WATERSHED BOUNDARY
- FLOW LINE
- NODE # / ELEVATION

EAGLE MOUNTAIN PROJECT

CM ENGINEERING ASSOCIATES



PLANNING AREA NO. 3
DRAINAGE MAP
EXHIBIT B-9

→ → **DRAINAGE PATTERN**

Appendix G
Biological Technical Report

Proposed Eagle Mountain Landfill Project:

Biological Technical Report

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February 1996

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Appendix A. Figures

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Summary

The objectives of this draft technical report are to provide supplemental information (1) to analyze the impacts of the proposed Project on the desert tortoise; (2) to analyze the effectiveness of proposed mitigation measures to protect tortoises; (3) to update the status of the desert tortoise on the proposed landfill site and along the proposed and alternate access roads; (4) to update RECON's 1991 technical report with new surveys to determine if project areas have changed since the original fieldwork and documentation was completed; (5) to assess the potential occurrence of newly and previously designated special-status species in the project area; (6) to identify additional measures that would help reduce impacts to desert tortoises, other special-status species, and the affected environment; and (7) to discuss new, applicable programmatic federal plans that regulate aspects of the proposed project.

Herein, Circle Mountain Biological Consultants presents (1) methods to review pertinent environmental documentation, assess biological resources that may occur in the project area, perform additional field surveys, and analyze proposed mitigation measures to protect desert tortoises; (2) results of those studies; (3) environmental consequences or potential impacts that may be associated with the project; and (4) mitigation measures proposed to avoid or minimize those impacts. Previous findings are summarized, and supplemental information is provided for the new Draft Environmental Impact Report/Environmental Impact Statement.

We address the judge's concern, from a previous court ruling, that the original Environmental Impact Report/Environmental Impact Statement was deficient in addressing the efficacy of proposed mitigation measures to protect tortoises. We concluded that there is evidence that the mitigation measures given in the federal Biological Opinion and other environmental documents for the project would protect tortoises during construction, operation, and maintenance of the landfill.

We concluded that the following biological resources could be significantly impacted if appropriate mitigation measures are not implemented: Alverson's foxtail cactus, desert pupfish, desert tortoise, common chuckwalla, Eagle Mountain Scrub Jay, California leaf-nosed bat, Townsend's big-eared bat, Nelson's bighorn sheep, and movement of bighorn sheep and deer across Salt Creek, between the Orocopia and Chocolate Mountains. We concluded that implementation of the mitigation measures identified herein and elsewhere in other regulatory documents would reduce all impacts to levels of not significant, with one exception: loss of the winter roost for California leaf-nosed bat and the possible maternity roost for Townsend's big-eared bat would likely occur in spite of mitigation measures to extend the adit and protect the roost.

Several topics, including cumulative effects and impacts to local and regional ecosystems, are not extensively discussed in this report, but are analyzed in the new Draft Environmental Impact Report/Environmental Impact Statement being prepared by CH2M HILL, for which this report is a technical appendix. Much of the information previously provided for this project, particularly RECON's work, is only summarized in this report; the reviewer will need to read those other documents for complete discussions of such topics.

Chapter 1
INTRODUCTION

This biological technical report is a technical appendix to the Draft Environmental Impact Report/Environmental Impact Statement (EIS/EIR) being prepared by CH2M HILL for the proposed Eagle Mountain Landfill Project (Project). Chapter 1 states the objectives and the need for this report, and briefly describes the Project. Chapter 2 discusses the methods used to review existing environmental documents and plans, conduct field surveys, perform a literature review, and analyze the efficacy of mitigation measures proposed for Eagle Mountain and used elsewhere to protect desert tortoises. The results are presented in Chapter 3. Impacts are discussed in Chapter 4, and Chapter 5 proposes mitigation for special-status species and the local environment. All existing environmental documents relative to Eagle Mountain are herein incorporated by reference and listed in Chapter 6.

All maps, referred to as Figures, appear in Appendix A. Other appendices list plants and animals identified in Project areas (Appendix B.), special-status species reported from the area that are not expected to be significantly impacted by the Project (Appendix C.), data collected to determine the efficacy of mitigation measures to protect desert tortoises during construction and operation of the proposed landfill (Appendix D.), and persons contacted to complete this report (Appendix E.).

Cumulative effects to Joshua Tree National Park and resulting from reoccupation of Eagle Mountain Townsite are not discussed in this report, but appear in the text of the Draft EIS/EIR, which has been reviewed by Circle Mountain Biological Consultants (CMBC).

The objectives of this report are to:

- analyze the impacts of the proposed Project on the desert tortoise, including the effectiveness of proposed mitigation measures;

- update the status of the desert tortoise on the proposed landfill site and along the proposed (Eagle Mountain Road) and alternative (Kaiser Road) access roads;

- update the technical report by demonstrating, if appropriate, that the environment has not significantly changed since the original fieldwork and documentation was completed;

- report the occurrence of additional special-status species that were not considered or incompletely considered in RECON's 1991 technical biological report;

- identify additional measures that would effectively reduce impacts to desert tortoises, other special-status species, and the affected environment;

- discuss new, applicable programmatic federal plans (i.e., those that were not in place in 1992 when the original EIS/EIR was completed);

Need For This Report.

In 1992, an EIS/EIR was prepared for the proposed Eagle Mountain Landfill Project (USDI Bureau of Land Management and Riverside County 1992). The County of Riverside (County) was the Lead Agency under the California Environmental Quality Act (CEQA) and the U.S. Department of the Interior, Bureau of Land Management (Bureau) was the Lead Agency under the National Environmental Policy Act (NEPA). The County issued its approvals and certified the EIR on November 3, 1992. The Bureau issued its Record of Decision (ROD) approving the land exchange and associated rights-of-way on October 20, 1993. The ROD was later appealed and a new EIS/EIR required.

The County's certification of the EIR and approval of the Project was challenged by three actions filed in State Court in December of 1992. On July 26, 1994, the San Diego County Superior Court issued Statements of Decision for the three cases, stating that the EIR was deficient in several areas. The Court entered Judgement and issued Writs of Mandate in the three actions on September 1, 1994, and October 18, 1994. These Writs ordered the County to prepare a new EIR, which in part, needs to further analyze the impacts of the proposed Project on the desert tortoise and the effectiveness of any proposed mitigation measures to protect tortoises.

Project Description.

Mine Reclamation Corporation (MRC) and Kaiser Eagle Mountain, Inc. (Kaiser), collectively "Proponents," propose to develop a landfill and recycling center within the boundaries of the inactive Kaiser Eagle Mountain Mine, in eastern Riverside County, California (Figure a.). A complete Project description is given in the Draft EIS/EIR, and summarized as follows:

Proposed landfill. The Project would include a Class III non-hazardous municipal solid waste landfill (landfill) and improvements to the existing Townsite of Eagle Mountain (Townsite). The landfill would serve Riverside, San Bernardino, Imperial, Los Angeles, Orange, Ventura, and San Diego Counties, and local areas (e.g., the Chuckwalla Valley and Blythe). No waste would be accepted from out-of-state sources. The location of the proposed Eagle Mountain Landfill and Recycling Center Project is approximately 97 km (60 miles) east of Indio, in the Chuckwalla Valley, roughly 17.7 km (11 miles) north of Desert Center, in the eastern portion of Eagle Mountains (Figure b.).

The proposed landfill site encompasses approximately 4,654 acres, of which 2,262 would be used for actual landfilling. Roughly 350 acres would be used for landfilling in the first 15 years of operation. The total capacity of the landfill over the expected life span of 100 years (to "build-out") would be approximately 670 million tons, accommodating up to 20,000 tons of waste per day. Final elevations would range from about 366 to 834 m (1,200 to 2,738 feet). A buffer area and ancillary facilities would occupy an additional 2,000 acres (Figure c.). Of the approximately 2,262 acres that would be used for landfilling, approximately 1,038 acres (Figure d.) are significantly disturbed by prior mining activities; i.e., no longer suitable habitat for most desert-adapted plants and animals.

The site would be developed in five phases, each with a capacity of between 100 and 200 million tons (Figure c.). Construction and operation of the landfill would proceed from east to west. The landfill would operate in limited areas of 15-50 acres at any one time with a working face of about two acres at any given time. These areas would be closed as new areas are opened for operation. The landfill would operate six days per week, primarily during daylight hours, although waste could arrive 24 hours per day.

Wastes to be disposed of in the landfill would be sorted and screened for recyclable and hazardous materials several times before disposal. First, municipal solid waste would be inspected as it is collected from residences or commercial sources. All incoming waste would also be processed at a materials recovery facility (MRF) or transfer station (TS). All recyclable and potentially hazardous materials would be removed at the MRF or TS. These facilities are not proposed as a part of this Project, and would be built and operated by other entities.

Proposed access road and rail line. Waste to be disposed of in the landfill would be transported to the site by rail on an existing but seldom used rail line owned by Kaiser (Figure a.), on existing Southern Pacific rail lines, and by commercial garbage trucks and private vehicles from the local area. Waste would be transported in closed containers to prevent leaking liquids and windblown trash. No more than 100 transfer truck round-trips and six train round-trips would be permitted daily.

The Kaiser rail line extends for 83.8 km (52 miles) from the existing mine site to Ferrum Junction, where it meets the Southern Pacific line passing through the Coachella Valley. Two rail yards are planned to receive waste. The total capacity of both yards would eventually reach about 26,000 tons of waste per day (the equivalent of approximately 7.3 trains per day).

Up to 2,000 tons of waste per day may be transported to the landfill by truck. Waste from Chuckwalla Valley or Blythe would be transported by truck, and from outside these areas by transfer trailers. Less than 10 tons per day of waste from local sources is expected. Road access is proposed via Eagle Mountain Road from Interstate 10, and the last 3.2 km (two miles) of Kaiser Road south of the Townsite; Kaiser Road is proposed as the alternative access road. An existing haul road between Eagle Mountain Road and Kaiser Road would be upgraded for use.

Proposed land exchange. The Bureau proposes to exchange 3,481 acres of Public Lands within the Project boundary for 2,846 acres of other desert lands owned by Kaiser. Much of the 3,481 acres is degraded or disturbed; only about 1,040 acres are currently undeveloped within the proposed footprint. Rights-of-way for the Eagle Mountain Railroad and Eagle Mountain Road would also be granted. These exchange and right-of-way grants would take place under the provisions of the Federal Land Policy and Management Act (FLPMA). The exchange and right-of-way grants must be implemented before landfill operations can begin.

Eagle Mountain Townsite. The existing Townsite occupies approximately 460 acres just south of the proposed landfill site (Figure a.). It consists of 339 residential units, 14 other partial residential units, 49 residential foundations/slabs, some commercial buildings, paved private interior streets, a water storage and distribution system, a fire station, an elementary school, telephone and electric facilities, and a 500-bed return-to-custody correctional facility. When the mine was active, as many as 3,700 people resided in the Townsite. Iron ore mining operations at the site ended in approximately 1983.

Currently about 220 people reside in the Townsite, and roughly 420 inmates are housed at the correctional facility. Of 339 available residential units, 112 are occupied by employees of Kaiser and of Management Training Corporation (MTC), which operates the correctional facility. There are 197 vacant units, which would be used for housing landfill workers and their families. Approximately half of the 460 acres in the Townsite are developed. The remaining acreage is planned to remain as open space or a similar designation in the Townsite Specific Plan. The Townsite Specific Plan would also provide residents with neighborhood services, such as a mini-mart and post office, capable of being supported by the community. Existing buildings would be used to supply these services and other community needs, such as churches, parks, and community center.

Proposed mitigation. Within this report and in previous environmental documentation are mitigation measures, monitoring plans, contingency plans, and conservation strategies intended to offset any adverse effects of the proposed landfill and reactivation of the rail line. These plans and strategies would be incorporated into the project description and plan of operations, restricting certain activities, monitoring others, and providing for conservation of desert ecosystems in Riverside County. The U.S. Fish and Wildlife Service (Service) has determined that neither desert tortoises nor desert pupfish, the only two federally listed species that may be impacted, would be jeopardized if these mitigation measures are implemented (USDI Fish and Wildlife Service 1992a). Operation of the landfill would result in a tipping fee of one dollar per ton of refuse, which, at maximum dumping capacity, would result in $20,000 per day to be used for conservation purposes. These funds would be used to purchase and preserve lands in the Colorado and Mojave Deserts of Riverside County, as described in Chapter 3 (see California Department of Fish and Game 1994b).

Chapter 2
METHODS

Herein, methods are described for (1) review of existing environmental documents and plans, (2) literature review of special-status species reported from the Project area, (3) field studies completed to date, and (4) assessing the efficacy of mitigation measures proposed to protect desert tortoises during construction, operation, and maintenance of the landfill.

Review of Existing Environmental Documents, Plans, and Literature.

Environmental documents and plans reviewed for this technical report are listed below. Each of these documents is incorporated by reference.

Federal documents.

- "Joshua Tree: General Management Plan, Development Concept Plans, Environmental Impact Statement." Developed by Joshua Tree National Park, Twentynine Palms, California. (National Park Service 1995).

- "Conference Report on the California Desert Protection Act of 1994. Conference Report 103-832 during the Second Session of the 103rd Congress." Prepared by the U.S. House of Representatives, dated October 4, 1994. (U.S. House of Representatives 1994).

- "Desert Tortoise (Mojave Population) Recovery Plan". Prepared by the Desert Tortoise Recovery Team for the Service, dated June 1994. (USDI Fish and Wildlife Service 1994c).

- "50 CFR part 17. Determination of Critical Habitat for the Mojave Population of the Desert Tortoise; Final Rule." Published Tuesday, February 8, 1994 in the *Federal Register* (USDI Fish and Wildlife Service 1994b).

- "Record of Decision. Eagle Mountain Landfill Project, Riverside County, California. Land Exchange CACA-30070, Right-of-Way Grant CACA-25594, Right-of-Way Grant CACA-31936." Produced by the Bureau, dated October 20, 1993, in compliance with NEPA and Section 206(a) of the Federal Lands Management Policy Act (FLPMA) (U.S.C. 1716). (USDI Bureau of Land Management 1993).

- Response to a request for formal Section 7 Conference on the Eagle Mountain Landfill Project, in reference to proposal of critical habitat for the desert tortoise. Correspondence from the Service to MRC, dated September 20, 1993. (USDI Fish and Wildlife Service 1993b).

- "Memorandum of Agreement between the National Park Service, California Department of Fish and Game, and Mine Reclamation Corporation to conduct a study of desert bighorn movements and habitat use in the area of the proposed Eagle Mountain Landfill Project, California." Signed by the Regional Director of the National Park Service on August 17, 1993. (National Park Service 1993).

- "Biological Opinion for the Eagle Mountain Landfill Project (1-6-92-F-39)." Prepared by the Service, dated September 10, 1992, pursuant to section 7 of the Endangered Species Act. (USDI Fish and Wildlife Service 1992a).

- "Final Environmental Impact Statement, Environmental Impact Report for the proposed Eagle Mountain Landfill Project. Specific Plan No. 252. State Clearinghouse No. 8908413." Prepared for the Bureau and County of Riverside, dated June 1992. (Three Volumes). (USDI Bureau of Land Management and Riverside County 1992).

• "Biological Assessment for the Eagle Mountain Landfill Project." Prepared by RECON for the Bureau, dated April 8, 1992, as required by Section 7 of the Endangered Species Act. (RECON No. 2100B) (RECON 1992a).

• *The California Desert Conservation Area Plan*. Prepared by the Desert District of the Bureau, dated 1980. (USDI Bureau of Land Management 1980b).

• "Final Environmental Impact Statement and Proposed Plan for the California Desert Conservation Area. Volume B. Appendix III: Wilderness". Prepared by the Desert District of the Bureau, dated September 1980. (USDI Bureau of Land Management 1980a).

• "Salt Creek Pupfish/Rail Habitat Area of Critical Environmental Concern Management Plan (CA-06ACEC-60)". Prepared by the California Desert District, Indio Resource Area office of the Bureau, dated September, 1982. (USDI Bureau of Land Management 1982).

• "Record of Decision to the 1984 Plan Amendments of the California Desert Conservation Area". Prepared by the Desert District of the Bureau, dated August, 1985. (USDI Bureau of Land Management 1985).

• "Bureau of Land Management California Statewide Wilderness Study Report." Prepared by the Bureau, dated 1990. (USDI Bureau of Land Management 1990).

• "Draft Chuckwalla Bench ACEC Management Plan and EA". The final version of this plan is in Preparation by the Palm Springs California Desert District office of the Bureau. (USDI Bureau of Land Management undated).

State documents.

• "Waiver of 401 Water Quality Certification for the Eagle Mountain Landfill Project." Signed June 22, 1994, by the Executive Office of the California Regional Water Quality Control Board, Colorado River Basin, Region 7. (California Regional Water Quality Control Board 1994).

• Notification No. 5-51-93, "Agreement regarding proposed stream or lake alteration." Signed June 8, 1994, by the California Department of Fish and Game. (California Department of Fish and Game 1994c).

• "California Endangered Species Act Memorandum of Understanding [CESA MOU] by and between Mine Reclamation Corporation and California Department of Fish and Game regarding Eagle Mountain Landfill Project." Dated March 29, 1994, and signed May 13, 1994 by the Director of the California Department of Fish and Game, under authority of section 2081 of the California Fish and Game Code. (California Department of Fish and Game 1994b).

Contracted documents.

• "Winter Baseline Surveys for Bats of the Eagle Mountain Project Site, Riverside County, California." Unpublished report prepared by Dr. Pat Brown on 20 January 1996. (Brown 1996).

• Correspondence from Gerry Scheid, Senior Biologist, RECON to Orlo Anderson, MRC, regarding Eagle Mountain Landfill - Alverson's foxtail cactus mitigation trial (RECON No. 2481L), dated May 5, 1995. (RECON 1995).

• "First annual report. Bighorn sheep monitoring program for the Eagle Mountain Landfill Project." Prepared by Darren Divine and Dr. Charles L. Douglas, National Biological Service Cooperative Studies Unit, University of Nevada, Las Vegas, for MRC, dated September 1994. (Divine and Douglas 1994).

• "Status report for the Eagle Mountain landfill biological mitigation and monitoring program, Riverside County, California." Prepared by RECON for MRC, dated September 2, 1994. RECON No. 2481N. (RECON 1994b).

• "Annual summary report for the Eagle Mountain landfill biological mitigation and monitoring program, Riverside County, California." Prepared by RECON for MRC, dated May 26, 1994. RECON No. 2481B. (RECON 1994a).

• "Eagle Mountain landfill project. Research design for the desert tortoise long-term monitoring plan." Prepared by RECON for MRC, dated February 10, 1994. RECON No. 2481F. (RECON 1994c).

• "Work plan. Biological resources mitigation and monitoring program. Eagle Mountain." Prepared by RECON for MRC, dated October 8, 1992. (RECON 1992b).

• "Biological technical report for the Eagle Mountain landfill project." Prepared by RECON, No. 2100B, for MRC, dated June 7, 1991. (RECON 1991).

Other pertinent plans:

• Northern and Eastern Colorado Desert Coordinated Management Plan (USDI Bureau of Land Management in prep.).

Literature Review for Special-Status Species.

Special-status species. The California Natural Diversity Data Base (California Department of Fish and Game 1994d) was reviewed to determine special-status species reported from the following United States Geological Survey (USGS) 7.5' quadrangle maps: Placer Canyon, Pinto Wells, Buzzard Spring, Victory Pass, Hayfield, Hayfield Spring, Desert Center, Red Canyon, Frink NW, and Durmid.

Status designations. Current plant and animal species statuses were determined using the following sources:

• "50 CFR Part 17. Endangered and threatened wildlife and plants; animal candidate review for listing as endangered or threatened species; proposed rule." (USDI Fish and Wildlife Service 1994b).

• "50 CFR 17.11 & 17.12. Endangered and threatened wildlife and plants." (USDI Fish and Wildlife Service 1993a).

• "California Department of Fish and Game natural diversity data base. Special animals." (California Department of Fish and Game 1994e).

• *California Native Plant Society's Inventory of Rare and Endangered Vascular Plants of California.* (Skinner and Pavlik 1994).

• "California Department of Fish and Game Natural Heritage Division. Plant conservation program. Endangered, threatened, and rare plants of California." (California Department of Fish and Game 1995).

Field Surveys.

Previous studies. RECON's technical report (1991) states methods used for their field surveys, which are briefly summarized as follows. RECON spent a total of 550 person hours, or 69 person days, between October 30 and November 11, 1989, and on November 28, 1989 and June 24, 1990 surveying biological resources on the mine site (104 hours), along the rail line (312 hours), along Eagle Mountain Road (54 hours), and on Kaiser properties proposed for exchange (80 hours).

Special studies have included:

- small mammal trapping in 1989 and 1990 by RECON on the Kaiser properties and along the rail line;

- desert pupfish studies in 1990 along Salt Creek by Allen Schoener and at an alkali pond 0.4 km (one-quarter mile) north by Kim Nicol of the California Department of Fish and Game (Department);

- water quality studies along Salt Creek in 1993 by RECON and Quality Assurance Laboratories to determine presence of diesel fuels or other petroleum products;

- focused bat studies by Dr. Pat Brown in 1990, 1992, 1993, and 1996 on several adits (mine entrances) on the mine site;

- monitoring by RECON since 1993 to evaluate the movements and reproductive conditions of 27 adult female tortoises in the vicinity of Eagle Mountain Road and the rail line;

- 11 train trips along the rail line during March, April, and September 1993, during which 23 tortoises were moved from harm's way;

- a two year study begun in March 1993 by RECON to determine baseline populations of Common Ravens in the region;

- 40 hours searching for raven nest sites near the proposed landfill, during which time nests were examined to determine whether or not they were active and if there was any evidence of tortoise predation.

Current (1995) studies. CMBC conducted studies in 1995 to:

- survey undeveloped areas on the mine that were not surveyed by RECON, and survey zone of influence areas adjacent to the proposed landfill, Eagle Mountain Road, and Kaiser Road;

- provide an independent assessment of the presence or absence of tortoise habitat on the proposed landfill site;

- determine whether the environmental setting has changed since RECON's 1989 and 1990 surveys; and

- collect additional data on existing biological resources and map locations of special-status species.

No new surveys were performed:

- along the railroad south of Interstate 10;

- on Kaiser's exchange lands; or

- along Salt Creek or its tributaries.

Results of previous studies and surveys are briefly summarized in Chapter 3. In each case where additional surveys were not performed, CMBC considered the existing information to be sufficiently complete and comprehensive to assess the expected impacts for that portion of the proposed Project.

Surveyors in 1995 included independent consultants Alice Karl, Peter Woodman, Dave Roddy, and Steve Gardner, and CMBC biologist, Ed LaRue. Cameron Patterson and Gina Shultz, then both of RECON (as of June 1995, Shultz works for the Service), met with Karl, Woodman, and LaRue on 30 January 1995 to familiarize the surveyors with the site, and to assist with surveys.

LaRue and Sharon Dougherty, of CMBC, revisited Eagle Mountain Road for approximately 2.5 hours and the northwestern and north-central portions of the proposed landfill for 5.0 hours on 22 March 1995. Many annual plants and several reptile species not detectable in late January and early February were identified and recorded during the late March visit. Additionally, LaRue and Dougherty spent approximately 5.0 hours driving the road parallel to the railroad between Interstate 10 and Salt Creek. Animals observed during that "windshield survey" (including an adult tortoise 2.4 km (1.5 miles) south of Interstate 10) were recorded, although the purpose of that drive was to familiarize LaRue and Dougherty with the area rather than inventory biological resources.

Between January 30 and February 5, 1995 a total of 36.25 hours were spent surveying areas east, northeast, and south of the proposed landfill area. During 1989 and 1990 surveys, RECON had not surveyed most of these adjacent areas because they were outside the proposed landfill footprint. Since then, the Service recommends that adjacent areas be surveyed by transects at 30, 91, 183, 366, and 732 m all sides of a given project area (USDI Fish and Wildlife Service 1992b), which CMBC did, in part, during 1995 surveys (Figure e.). Areas north, northwest, west, and southwest of the proposed landfill are very rugged, steep terrain, which CMBC considered to be marginal, if not unsuitable tortoise habitat. Since no tortoise sign was found in areas of similar topography on the mine site, those adjacent areas were not surveyed.

Woodman, LaRue, and Roddy spent 42.75 hours over a three-day period surveying areas within the proposed landfill. Transects were surveyed in areas where RECON had not surveyed, as shown in Figure e. Thus, given RECON's surveys and those performed by CMBC, most of the undeveloped portions of the proposed landfill area have been inventoried and assessed for biological resources.

Woodman, LaRue, Gardner, and Roddy spent approximately 53 hours surveying areas east and west of Kaiser Road, between the mine site and the community of Desert Center and approximately 47 hours surveying areas east and west of Eagle Mountain Road, between Interstate 10 and the aqueduct road, south of the mine site. RECON had surveyed areas out to 30 m east and west of Eagle Mountain Road, but had not surveyed any part of Kaiser Road or the zone of influence around Eagle Mountain Road. CMBC surveyed areas adjacent to the two roads so that they could be reasonably compared in the alternatives analysis required under CEQA and NEPA. Surveys were structured to allow direct comparisons between the Eagle Mountain Road and Kaiser Road access road alternatives. Therefore, transects were surveyed at the shoulders, 183, 366, and 732 m east and west of each of the roads.

For all surveys, the biologists focused on detecting special-status species, particularly desert tortoise, which is the only state- or federally-listed threatened or endangered species known to occur in the vicinity of the access road(s) and proposed landfill site. All plants and animals observed during surveys were recorded, and are listed in Appendix B. Special-status species were described in field notes and located on maps provided by MRC and/or RECON. Surveyors generally used topographical or manmade features and calibrated pacing to map these resources. Plants that could not be identified in the field were collected and subsequently identified using regional field guides (Hickman 1993, Munz 1974, Jaeger 1941) or by Andrew Sanders, Herbarium Curator, at the University of California, Riverside Botanical Garden.

Analysis of Mitigation Measures to Protect the Desert Tortoise.

In this section, CMBC discusses the methods implemented to review the record to determine if the mitigation measures given in Eagle Mountain's Biological Opinion would adequately protect tortoises during construction and operation of the landfill, railroad, and access road.

In California, there have been approximately 150 federal Biological Opinions issued for the desert tortoise by the Ventura and Carlsbad offices of the Service; more than 180 have been issued out of the Reno and Las Vegas offices of the Service in Nevada. Each of these opinions includes: (1) a jeopardy or non-jeopardy opinion, (2) measures proposed by the federal Lead Agency to minimize impacts, (3) an incidental take statement, which lists the number of tortoises that may be accidentally killed and the number that may be handled, and (4) the terms and conditions that are to be implemented to ensure that the take limits are not exceeded.

The objectives of this study were (1) to obtain all Biological Opinions addressing desert tortoises; (2) to determine for each opinion the number of tortoises that may be handled and accidentally killed; (3) to determine the similarities and differences between the measures given in those Biological Opinions with the measures given in the Biological Opinion issued for Eagle Mountain; (4) and to determine the actual numbers of tortoises handled and accidentally killed during construction, maintenance, and operation of those projects. Then, given this information, (5) to determine if tortoises would be adequately protected by the mitigation measures proposed for Eagle Mountain.

The objectives were met, in part, as follows:

- A total of 126 federal Biological Opinions for projects affecting tortoises in California was obtained from the Ventura and Carlsbad, California offices of the Service. An additional 108 opinions were obtained from the Reno, Nevada office of the Service.

- Opinions issued for the desert tortoise relative to livestock grazing and motorized racing events were considered to be sufficiently different from the proposed Eagle Mountain Project that they were excluded from the analysis.

- The following information was tabulated for each Biological Opinion: (1) project name, location, federal identification number, date issued, and office issuing the opinion; (2) project type and number of acres expected to be impacted; (3) project proponent, federal Lead Agency, and, where possible, the name of the consulting firm implementing the terms and conditions; (4) the anticipated harassment and mortality take limits; (5) the actual harassment and mortality take limits as reported by the federal Lead Agency, project proponent, biological monitor, or other knowledgeable individuals; and (6) the mitigation measures given in each opinion that are (a) similar and (b) different from those given in Eagle Mountain's Biological Opinion.

- Biological monitors and other individuals were contacted to determine the actual number of tortoises handled and accidentally killed during implementation of the terms and conditions.

- CMBC met with representatives of the primary federal Lead Agencies (i.e., Bureau in California and Nevada, and Edwards Air Force Base in California), and either discussed the Biological Opinions with staff or evaluated case files, which track project status.

- CMBC produced a list of mitigation measures that were not included in Eagle Mountain's opinion.

- Approximately 145 individuals were contacted during this study (Appendix E.).

- CMBC met with Service personnel to discuss the function of Biological Opinions, the intent of mortality and harassment take limits, and their comments on the interpretation of the data.

Chapter 3
RESULTS

Results are described for (1) review of existing environmental documents and plans, (2) literature review of existing environmental conditions and special-status species reported from the Project area, (3) field studies completed to date, and (4) the efficacy of mitigation measures proposed to protect desert tortoises during construction, operation, and maintenance of the landfill.

Review of Existing Environmental Documents, Plans, and Literature.

The following documents contain management prescriptions, conservation strategies, and other pertinent agency mandates that regulate areas adjacent to or occupied by the proposed Project.

Federal documents.

- "Joshua Tree: General Management Plan, Development Concept Plans, Environmental Impact Statement." (National Park Service 1995).

  In October of 1994, Joshua Tree National Monument was changed to a National Park, and 234,000 acres were added. Areas adjacent to the proposed landfill site were included, and designated as wilderness. This document mentions specific concerns of the Park Service with regard to the proposed Project. These include "impacts to the desert tortoise and other wildlife, trash blowing, leaks, and air quality degradation," "dust, noise, and odors," attracting "scavengers such as ravens and coyotes," and "water quality." The Park Service is also concerned that the Project and other adjacent uses could "diminish the naturalness and solitude of the wilderness." Management plans for the new wilderness areas adjacent to the proposed landfill site have not been prepared to date.

- "Conference Report on the California Desert Protection Act of 1994. Conference report 103-832 during the second session of the 103rd Congress." (US House of Representatives 1994).

  The U.S. House of Representatives designated 40,735 acres in the Orocopia Mountains as wilderness, which include some areas within approximately 1.6 km (one mile) of the rail line. The bighorn sheep herd, desert tortoise, and sensitive plant populations are among the special features contributing to the wilderness value of the area (USDI Bureau of Land Management 1990). In the same Act, Congress designated 80,770 acres of wilderness on the Chuckwalla Bench. Special features in this area include Prairie Falcon eyeries (cliff nest sites), a population of bighorn sheep, and sensitive plant species. The rail line comes within 3.2 km (two miles) of the northwest edge of this wilderness area. Management of wilderness areas must generally meet the following guidelines, among others: (1) perpetuate the wilderness resource, (2) maintain the plants and animals indigenous to the area, and (3) consider protection needs for populations of threatened or endangered species and their habitats. Any proposed actions should be designed and mitigated to avoid any conflict with these guidelines.

- "Desert Tortoise (Mojave Population) Recovery Plan" (USDI Fish and Wildlife Service 1994c).

  The Recovery Plan for the desert tortoise recommends management of critical habitat and other habitat occupied by this population of tortoises. The plan is based on six separate recovery units: Northern Colorado, Eastern Colorado, Upper Virgin River, Eastern Mojave, Northeastern Mojave, and Western Mojave Recovery Units. The rail line and southern portion of Eagle Mountain Road are within the Eastern Colorado Recovery Unit (Figure f.). Within recovery units, the plan recommends the establishment of Desert Wildlife Management Areas (DWMAs) (Figure f.). Agencies responsible for the lands in these areas are encouraged to define boundaries based on the plan's recommendations and consultation with the Service and "through a planning process that is coordinated with local government and interested members of the public," and to adopt management plans for these areas following guidelines for the recovery of desert tortoises outlined in the plan (USDI Fish and Wildlife Service 1994a, 1994c). Critical habitat may be adjusted to "correspond to the DWMAs" once they are established (USDI Fish and Wildlife Service 1994a).

The proposed landfill is located at the eastern end of the proposed Joshua Tree DWMA (Figure f.). Recommended regulations for DWMAs that may affect proposed Project activities include prohibition of "clearing for agriculture, landfills, or any other surface disturbance that diminishes the capacity of the land to support desert tortoises, other wildlife, and native vegetation," prohibition of "dumping and littering," "limited speed travel on designated, signed roads and maintenance of these roads," permitting of "non-intrusive monitoring of desert tortoise dynamics and habitat" (USDI Fish and Wildlife Service 1994c). The Service further recommends that the responsible agencies "allow no new landfills or sewage ponds within DWMAs" and "reduce or eliminate use of authorized landfills and sewage ponds in and near DWMAs by predators of desert tortoise (e.g., ravens & coyotes)." The Service specifically recommends "construct[ion of] desert tortoise barrier fencing to protect desert tortoises and their habitat from human activities ... along the north side of the DWMA boundary and along the road from Cottonwood Pass through the Monument and from Desert Center to the Eagle Mountain Mine" in the Joshua Tree DWMA (USDI Fish and Wildlife Service 1994c). Relative to reactivating the rail line, the Service recommended "Restrict train traffic to 1991 levels or construct barrier fencing and desert tortoise underpasses along the railroad tracks to reduce or eliminate mortality and population fragmentation." In addition, the Service suggests that "research on desert tortoise predation, including level of raven predation at the Monument and adjacent urban areas, and raven predation as a reflection of certain types of human uses" be carried out.

- "50 CFR part 17. Determination of Critical Habitat for the Mojave Population of the Desert Tortoise; Final Rule." (USDI Fish and Wildlife Service 1994b).

  This document establishes critical habitat for the Mojave population of the desert tortoise. The Chuckwalla Unit includes areas north of I-10 through which the rail line and Eagle Mountain Road pass, and south of I-10 and north of the Chocolate Mountains through which the rail line passes (Figure f.). While designation of critical habitat does not constitute establishment of a management plan for these lands, the Service will not permit federal actions that "would likely result in the destruction or adverse modification of critical habitat" without providing "reasonable and prudent alternatives to the proposed action in its Biological Opinion." The Service has determined that reactivated rail line use and widening of Eagle Mountain Road, which are within critical habitat, would not adversely modify or destroy designated, desert tortoise critical habitat (USDI Fish and Wildlife Service 1993b). The proposed landfill site is not within critical habitat.

- "Record of Decision. Eagle Mountain Landfill Project, Riverside County, California. Land Exchange CACA-30070, Right-of-Way Grant CACA-25594, Right-of-Way Grant CACA-31936." (USDI Bureau of Land Management 1993).

  The ROD was authorized but later appealed, resulting in the need to prepare this new EIS/EIR.

- Response to a request for formal section 7 conference on the Eagle Mountain Landfill Project, in reference to proposal of critical habitat for the desert tortoise. (USDI Fish and Wildlife Service 1993b).

  This correspondence indicates that the Project as proposed would not adversely affect recently designated critical habitat for desert tortoise (see "50 CFR part 17" above).

- "Memorandum of Agreement between the National Park Service, California Department of Fish and Game, and Mine Reclamation Corporation to conduct a study of desert bighorn movements and habitat use in the area of the proposed Eagle Mountain Landfill Project, California." (National Park Service 1993).

  This agreement sets out the terms of research on bighorn sheep populations in the Eagle Mountains, as part of the mitigation proposed in the previous EIS/EIR. Funding is provided by MRC to study the status and movements of the population, to conduct a radio telemetry study, to study genetic relationships between the Eagle Mountain herd and sheep in other areas, and to study and evaluate the metapopulation (i.e., a collection of small population units connected by the periodic exchange of genetic materials and individuals), its habitat use and movements within the Eagle, Coxcomb, and Little San Bernardino Mountains. The Park Service and the Department agreed to closely coordinate the research, which is being performed by Dr. Charles Douglas of the University of Nevada, Las Vegas. Thus far, two years of this monitoring program have been completed by Douglas, the Department, and Park Service.

- "Biological Opinion for the Eagle Mountain Landfill Project (1-6-92-F-39)." (USDI Fish and Wildlife Service 1992a).

  This document is discussed in detail in the section analyzing the efficacy of proposed mitigation later in this chapter.

- "Final Environmental Impact Statement, Environmental Impact Report for the Proposed Eagle Mountain Landfill Project. Specific Plan No. 252. State Clearinghouse No. 8908413." (USDI Bureau of Land Management and Riverside County 1992).

  This document is incorporated by reference. This technical report is intended to supplement the biological information provided in the previous EIS/EIR.

- "Biological Assessment for the Eagle Mountain Landfill Project." (RECON 1992a).

  The Biological Assessment is also incorporated by reference in this technical report.

- *The California Desert Conservation Area Plan.* (USDI Bureau of Land Management 1980b).

  The California Desert Conservation Area Plan (Plan) provides management prescriptions for a 12.1-million acre area (now reduced, due to transfer of lands to the National Park Service) in the California desert. The planning area encompasses the Project area, exclusive of private lands. Bureau lands in the vicinity of the proposed landfill site, near the access roads and the rail line north of I-10 are designated "Class M" for moderate use. South of I-10, along the rail line, Bureau lands are classified "Class L" for limited use in most areas. Some "Class C," controlled use lands (i.e., wilderness or wilderness study areas) are present in the Orocopia Mountains and the Chuckwalla Bench. Definitions for these classes are given in the Plan (USDI Bureau of Land Management 1980b).

  The development of the landfill will require exchange of Bureau lands (Class M) in the vicinity of the proposed site, so that Plan standards for this area would no longer apply. Rail and access road uses would not conflict with Class M standards or Class L standards, so long as the use is "carefully controlled...ensuring that sensitive values are not significantly diminished" (USDI Bureau of Land Management 1980b). Wilderness lands near the rail line (Class C) are not likely to be directly impacted by the Project, although wildlife movement between these areas may be affected. Specific impacts to these animals are discussed in Chapter 4.

  The Plan discusses management of "Unusual Plant Assemblages" (UPAs), which are stands of vegetation "which can be recognized as extraordinary due to one or more factors." UPAs found within areas that may be affected by the Project include salt or brackish water marshes, seeps and springs, and all wetland and riparian areas, most of which are found adjacent to the rail line, particularly to the south in the Salton Sink. The Plan specifies that "where possible, impacts on these UPAs will be avoided; where impacts cannot be avoided, every effort will be made to achieve the least degree of impact and to mitigate the areas through rehabilitation to stable conditions before or during the action." Thus the effects of the rail line on riparian and wetland areas must be avoided or mitigated.

- "Final Environmental Impact Statement and Proposed Plan for the California Desert Conservation Area. Volume B. Appendix III: Wilderness." (USDI Bureau of Land Management 1980a).

  Wilderness designation is proposed for areas near the rail line in the Orocopia Mountains and Chuckwalla Bench. Final designation for these areas was accomplished by the Desert Protection Act of 1994. (See discussion of the Desert Protection Act earlier in this section).

• "Salt Creek Pupfish/Rail Habitat Area of Critical Environmental Concern Management Plan (CA-06ACEC-60)." (USDI Bureau of Land Management 1982).

The Salt Creek ACEC was designated specifically due to the presence of desert pupfish in Salt Creek and its tributaries. The "Record of Decision to the 1984 Plan Amendments of the California Desert Conservation Area" (USDI Bureau of Land Management 1985) enlarged the Salt Creek Pupfish/Rail Habitat ACEC by 2,200 acres of public land for a total area of 4,703 acres. Project activities planned along the rail line in the vicinity of the Salt Creek ACEC should avoid or mitigate conflicts with the objectives and provisions of the plan. The principal goal of the ACEC is to protect and enhance desert pupfish and rail habitat. The long-term goal of the ACEC's management is "to ensure that desert pupfish can utilize the Salt Creek drainage to its fullest extent" (USDI Bureau of Land Management 1982). Mitigation of effects to these species should include "habitat improvement such as additional water sources." Other potential mitigation could include assisting the Bureau with planned management actions including "clear[ing] vegetation, predominantly common cane and tamarisk, from Salt Creek between Highway 11 and railroad bridge;" "remov[ing] tamarisk from public land in [Sections] 14, 22, and 23, T. 8 S., R.11 E. ... by hand/mechanical means;" "develop[ing] a set of alternatives to control the spread of exotic fish in Salt Creek and eliminate exotic fish already in Salt Creek;" and implementing a monitoring program (USDI Bureau of Land Management 1982).

• "Record of Decision to the 1984 Plan Amendments of the California Desert Conservation Area." (USDI Bureau of Land Management 1985).

This document indicates the commitment of the Bureau to manage lands in the California Desert Conservation Area according to the management program outlined in the Plan, as described above.

• "Bureau of Land Management California Statewide Wilderness Study Report." (USDI Bureau of Land Management 1990).

This document evaluates the suitability of a number of areas proposed for wilderness designation on Bureau lands, including areas in the Orocopia and Chuckwalla Bench, near the rail line. Special features described for the Orocopia Mountains include the resident herd of bighorn sheep, desert tortoise population, and several special-status plant species. Special features of the Chuckwalla Bench area include populations of burro deer, bighorn sheep, and desert tortoise, a number of special-status plants, and at least one Prairie Falcon eyerie. Final designation of these areas as wilderness took place under the Desert Protection Act of 1994, described earlier in this section.

• "Draft Chuckwalla Bench ACEC Management Plan and EA" (USDI Bureau of Land Management undated).

The final version of this plan is in preparation by the Palm Springs California Desert District office of the Bureau. The Chuckwalla Bench ACEC was established "in recognition of unique wildlife and vegetation values." Project activities and impacts should avoid impacts to the ACEC or mitigate them, so that the objectives and provisions of the draft plan for the area are not in conflict. Mitigation for impacts to the ACEC could include assisting the Bureau with the following proposed actions: (1) "develop a more accurate map of desert tortoise densities" and (2) "develop a monitoring program to determine the trend of wildlife and vegetation resources on the Bench" (USDI Bureau of Land Management undated).

<u>State documents.</u>

• "Waiver of 401 Water Quality Certification for the Eagle Mountain Landfill Project." (California Regional Water Quality Control Board 1994).

This correspondence indicates that the State has determined that the proposed Project "will not result in any discharge that would adversely impact the quality of waters of the United States. Therefore, a 401 Water Quality Certification is not required."

• Notification No. 5-511-93, "Agreement regarding proposed stream or lake alteration." (California Department of Fish and Game 1994c).

This agreement allows the Project Proponents to "divert or obstruct the natural flow of, or change the bed, channel, or bank of, or use material from the streambed(s) of the following water(s): 280 streams (railroad - 270; container handling yard - 7; landfill - 3), including Salt Creek and Big Wash, and all drainages from approximately Ferrum Junction, northeast to the Town of Eagle Mountain for the railroad portion, and north of the Town of Eagle Mountain to approximately 3.2 km (2 miles) north and 3.2 km west of the Town for the landfill and container handling yard." Thirty-four (34) conditions of the permit are specified, and include, in part: (1) construction of three detention/siltation basins adjacent to the handling yard to desilt storm flows and reduce flow velocities to natural levels before leaving the site; (2) limit impacts to 12.8 acres of stream including 6.6 acres by railroad crossings, 4.3 acres by road crossings, 0.8 acres on the landfill site, and 1.1 acres from construction of the container handling yard and three detention/siltation basins; (3) allow native vegetation to exist as much as possible, by cleaning only one basin per year, or clean one-third or one-half of each basin each year; (4) clear culverts of debris and repair or replace structures once annually, in September or October, after nesting season, when they are dry; (5) use no herbicides for any maintenance; (6) preserve 1,127 acres of on-site natural open space within the Project; (7) disturbed portions of any stream channel within the high water mark of the stream shall be restored to their original condition and revegetated with native vegetation; (8) limit access to the worksite to existing roads, rails, and access ramps; (9) use alternative means of erosion protection where vegetation cannot reasonably be expected to become reestablished; (10) location of staging and storage areas outside of streams; and (11) daily checking and maintenance of equipment and vehicles to prevent leaks of deleterious materials into streams/lakes.

• "California Endangered Species Act Memorandum of Understanding [CESA MOU] by and between Mine Reclamation Corporation and California Department of Fish and Game regarding Eagle Mountain Landfill Project." (California Department of Fish and Game 1994b).

This agreement sets out terms and conditions for the Project's compliance with the California Endangered Species Act. These include: (1) transfer of 375 acres of habitat management lands to the Bureau, to replace 150 acres lost or temporarily impacted, prior to the start of construction or operation of the landfill; and (2) payment to the County of $1.00 per each ton of non-hazardous municipal solid waste deposited at the landfill, pursuant to the terms of the Environmental Mitigation Trust (Trust). Eighty-five percent (85%) of these funds will be used for acquisition of natural open space in specific areas including wilderness areas proposed in the California Desert Protection Act (e.g., the Whitewater Wilderness Study Area (WSA), Santa Rosa Mountains WSA, Joshua Tree National Park, Mecca Hills WSA, Orocopia Mountains WSA, and Chuckwalla Mountains WSA). Fifteen percent (15%) is earmarked for acquisition of lands in other conservation areas including the Coachella Valley Fringe-toed Lizard Preserve, Chuckwalla Bench Desert Tortoise Area, Morongo Canyon ACEC, Dos Palmas/Salt Creek ACEC, and Santa Rosa Mountains National Scenic Area. If a sum of at least $35,000 is not received by the Department from the Trust during the first two years of the landfill's operation, MRC will deliver a stand-by letter of credit in an amount equal to the difference between $35,000 and any sums received by the Department from the Trust. Additional conditions include (3) cooperation with the University of California to establish an experimental population of the Salt Creek pupfish at the Deep Canyon Reserve, by paying a sum not to exceed $45,000 to construct an appropriate pool. Other conditions specific to the desert tortoise and desert pupfish are discussed in Chapter 4.

Contracted documents. Documents listed in Chapter 2 discuss the design and results of on-going and future monitoring programs. Pertinent portions of these documents are described later in this chapter and in Chapters 4 and 5.

Other pertinent plans.

• Northern and Eastern Colorado Desert Coordinated Management Plan (USDI Bureau of Land Management in prep).

Presently, the Bureau is coordinating a management effort inclusive of the Project area that is referred to as the "Northern and Eastern Colorado Desert Coordinated Management Plan." Approximate boundaries of this planning area are the Coachella Valley to the west, Mexican border to the south, Colorado River to the east, and Interstate 40 to the north. This management plan would result in the issuance of programmatic incidental take permits (i.e., federal Biological Opinion for federal projects and section 10(a)(1)(B) permit for private projects, and analogous state permits; i.e., section 2090 agreement and 2081 permit) authorizing take of threatened and endangered species within the planning area. The planning process is in its infancy, so that no management prescriptions have been adopted at this time (Joan Oxendine, Bureau, pers. comm. 16 June 1995), and implications for the proposed Project are not known. Oxendine indicated that new landfills within the planning area would not be permitted under the programmatic take permits issued for the region; such landfills would be required to obtain project specific permits.

Mitigation measures, contingency plans, monitoring plans, and other prescriptive measures have been developed to ensure that the proposed Project complies with the mandates given in each of the above state and federal documents. It will be the responsibility of the Bureau, as the federal Action Agency, and other regulatory agencies to ensure that MRC implements these measures and that the Project complies with the regulations delineated in these management plans.

Literature Review.

This section describes information obtained from existing literature regarding the local environment, common flora and fauna, and special-status species reported from the area.

Affected environment. The proposed landfill site is located in the eastern end of the Eagle Mountains (Figures a. and b.). Elevations on the site range from about 215 m in the bottom of the mine pit to 850 m in the northeast parts of the site. Mined areas with steep rock walls and deep quarried pits comprise the central part of the proposed site. Slopes and mounds of spoil from earlier mining operations are significant features of the present topography. Also included are relatively undisturbed canyons, rocky hillsides, and drainages. The Townsite has been described elsewhere.

Two roads, Eagle Mountain Road and Kaiser Road, provide access to the site from Interstate 10. Both roads are paved, with the exception of the northern end of Eagle Mountain Road. Kaiser Road passes through the town of Desert Center near the freeway. A small community with a golf course and an artificial lake, Lake Tamarisk, has been built about 4.0 km (2.5 miles) north of Desert Center, adjacent to Kaiser Road. Kaiser Road elevations range from about 275 m at I-10, to about 200 m at the low point where the road curves to the northwest, about 8.9 km (5.5 miles) north of I-10, to about 420 m at the mine. Elevations on Eagle Mountain Road range from about 350 m at its junction with I-10, to the low point at about 275 m above sea level approximately 4.0 km (2.5 miles) north. The elevation at Victory Pass, near the north end of Eagle Mountain Road, is about 330 m, and at a pumping station for the Colorado Aqueduct, just south of the proposed landfill site, is about 300 m. Both roads pass through gently sloping alluvium dissected with drainages for most of their length. Eagle Mountain Road traverses two passes, one near its northern end, and one at the base of the Eagle Mountains, through slightly steeper and more rocky terrain than encountered on Kaiser Road.

Presently, Eagle Mountain Railroad is occasionally used, originating at the Kaiser/Eagle Mountain Mine and extending 83.9 km (52 miles) south and west to the Southern Pacific railroad line at Ferrum Junction near the Salton Sea. The rail line and its right-of-way (rail line) pass over bajadas south of the mine and cross the Chuckwalla Valley. The rail line passes through the alluvial plain of the Chuckwalla Bench, about 4.8 km (three miles) west of the north end of the Chuckwalla Mountains, where a dirt road and levee parallel it to the west. The rail line crosses the levee and road and runs just west of these features as it curves west of the northwestern spur of the Orocopia Mountains. The rail line then flanks the Salt Creek Drainage that separates the Chocolate and Orocopia Mountains. It continues southwest, passing through wetland areas near the Salton Sea. Elevations on the rail line range from approximately 415 m above sea level at the mine to 50 m below sea level at Ferrum Junction. Most parts of the rail line are in relatively flat terrain, although the line passes through a steep sided canyon between the Orocopia and Chocolate Mountains.

Common wildlife and plant communities. Appendix B. lists the animal and plant species observed or detected within the Project areas during both RECON's and CMBC's surveys. Habitats in the Project areas have been described in RECON (1991), and are summarized as follows:

Habitats. Figure d. shows the distribution of plant communities found in the Project area. Most of the proposed site is vegetated by Sonoran creosote bush scrub, with creosote bush *(Larrea tridentata)* as the dominant species. Cactus species are found throughout undeveloped areas, and include silver cholla *(Opuntia echinocarpa)*, pencil cholla *(Opuntia ramosissima)*, cottontop *(Echinocactus polycephalus)*, hedgehog cactus *(Echinocereus engelmanni)*, and beavertail *(Opuntia basilaris)*. Alverson's foxtail cactus and California barrel cactus are two special-status species discussed elsewhere. Desert dry wash woodland, as described below, occurs along dry washes within the site.

Sonoran creosote bush scrub, interspersed with desert dry wash woodland, occurs adjacent to the access roads and on the eastern portions of the proposed landfill site. Dominant species in desert dry wash woodland are palo verde *(Cercidium floridum)*, ironwood *(Olneya tesota)*, catclaw *(Acacia greggii)*, smoke tree *(Psorothamnus spinosus)*, and indigo bush *(Psorothamnus polydenius)*. Common shrubs and herbaceous plants in dry washes include desert lavender *(Hyptis emoryi)*, sweetbush *(Bebbia juncea)*, and desert milk aster *(Stephanomeria pauciflora)*.

The rail line passes through Sonoran creosote bush scrub and some desert dry wash woodland north of I-10. South of I-10, desert dry wash woodland becomes more dominant along Salt Creek. Nearby areas on the Chuckwalla Bench have more diverse vegetation types, including Joshua tree woodland. Near the Salton Sea, the rail line is surrounded by desert chenopod scrub. This complex of plant communities includes areas of saltbush scrub near sea level, which are dominated by saltbush species such as four-winged saltbush *(Atriplex canescens)*, desert holly *(A. hymenelytra)*, wheel scale *(A. elegans)*, and allscale *(A. polycarpa)*. Where the elevation drops, wet alkali sinks are dominated by iodine bush *(Allenrolfea occidentalis)* and bush seepweed *(Suaeda moquinii)*, with scattered saltbush species interspersed. Within these sinks are some areas of desert greasewood scrub, which is dominated by the same species as saltbush scrub, but is far less dense, and less diverse. Alkali seeps are vegetated by saltgrass *(Distichlis spicata)* and other herbaceous plants that are adapted to high levels of salts.

Wildlife. Many animal species present in the Project areas are dependent on habitat features such as steep topography and rock outcrops, friable soils for burrowing, large shrubs or trees for roost sites, and certain plant communities. Steep slopes, rocky cliffs and canyons, and rock outcrops comprise much of the mine site and surround it to the north and west. Many of the animals known from the area are dependent on these features, including Rock Wren *(Salpinctes obsoletus)* and Canyon Wren *(Catherpes mexicanus)*. Several bat species use mine adits and tunnels for roost sites, because nearly tropical temperatures and humidities are maintained in these underground chambers, compared to the temperature extremes of the surface (Brown 1990). Other animals, such as the House Sparrow *(Passer domesticus)*, European Starling *(Sturnus vulgaris)*, and Common Raven *(Corvus corax)* are attracted to the area due to human presence and related alterations of the desert environment.

Species using desert dry wash habitats include Mourning Dove *(Zenaida macroura)*, Verdin *(Auriparus flavipes)*, and migrating warblers and songbirds, such as Yellow-rumped Warbler *(Dendroica coronata)*. Many other desert animals are attracted to wash areas as well. Densities of breeding birds in wash areas have been estimated at up to ten times the numbers found in adjacent desert scrub areas (USDI Bureau of Land Management undated).

Habitats near the rail line support a similar complement of animals, with some notable additions. One of the most significant populations of burro deer *(Odocoileus hemionus eremicus)* in California is found in the area of the Chuckwalla Bench and Chocolate Mountains (USDI Bureau of Land Management undated). These deer are found in bottomland habitats where willow, mesquite and screwbean predominate, and washes with ironwood and palo verde (Grinnell 1933). Does and fawns frequent smaller washes in this area. Burro deer concentrate near areas of permanent water during the dry season (Longhurst et al. 1952). The Department has carried out genetic studies of these deer and has not found significant differences from other mule deer. They consider burro deer as a locally adapted population in a unique habitat (Andrews pers comm., August 21, 1995). These animals use water sources located in the Orocopia and Chocolate Mountains within 3.2 km (two miles) of the rail line and travel extensively through the Salt Creek area (Andrews pers. comm. August 21, 1995).

Wetlands near the Salton Sea and Salt Creek and its tributaries support populations of many animals not often associated with the desert environment. Raccoons *(Procyon lotor)* and striped skunks *(Mephitis mephitis)*, as well as a number of water birds, including Virginia Rail *(Rallus limicola)* and Sora Rail *(Porzana carolina)* are found in and near wetland areas (USDI Bureau of Land Management 1982).

Special-status species. Review of materials listed in the methods section (especially the Natural Diversity Data Base) revealed 23 plant species and 1 plant community, 1 fish, 5 reptiles, 35 species of birds, and 11 mammals with special status that have been reported from the area or were addressed in previous environmental documentation for the proposed Project. These species, their status, and likelihood of occurrence are presented in Tables 3-1 to 3-4. Of these, 19 plants, 1 fish, 3 reptiles, 29 birds, and 9 mammals are potentially present in one or more areas of the Project, while the rest are considered absent due to lack of suitable habitat, distance from known range, or other reasons given in Appendix C.

Table 3-1 Special-Status Plants and Plant Communities Reported from the Region						Page 1 of 3
Common Name ***Scientific name***	**[1]Federal status**	**[1]State status**	**[2]CNPS status**	**[3]Probability of occurrence**		
				Landfill site	**Access roads**	**Rail line**
Desert Fan Palm Oasis Woodland	ND	ND	CHIP	Absent	Absent	Absent
Utah Vine Milkweed *Cynanchum utahense*	ND	ND	List 4 R - 1 E - 1 D - 1	Low	Low	Low
Spearleaf *Matelea parvifolia*	ND	ND	List 2 R - 3 E - 1 D - 1	Low	Absent	Absent
Mesquite Neststraw *Stylocine sonorensis*	ND	ND	List 2 R - 3 E - 3 D - 1	Low	Low	Low
Mecca-aster *Xylorhiza cognata*	C2	ND	List 1B R - 2 E - 2 D - 2	Absent	Absent	Absent
Orcutt's Aster *Xylorhiza orcuttii*	C2	ND	List 1B R - 2 E - 2 D - 2	Absent	Absent	Absent
Ribbed Cryptantha *Cryptantha costata*	ND	ND	List 4 R - 1 E - 1 D - 2	Moderate	Moderate	Moderate
Winged Cryptantha *Cryptantha holoptera*	ND	ND	List 4 R - 1 E - 1 D - 2	Moderate	Moderate	Moderate
Foxtail Cactus *Escobaria vivipara var. alversonii*	C2	ND	List 1B R - 2 E - 2 D - 2	Occurs	Occurs	Occurs

Table 3-1 Special-Status Plants and Plant Communities Reported from the Region						Page 2 of 3
Common Name ***Scientific name***	**[1]Federal status**	**[1]State status**	**[2]CNPS status**	**[3]Probability of occurrence**		
				Landfill site	**Access roads**	**Rail line**
California Barrel Cactus *Ferocactus acanthodes* var. *acanthodes*	BLM	ND	ND	Occurs	Occurs	Occurs
Munz's Cholla *Opuntia munzii*	C2	ND	List 1B R - 3 E - 1 D - 3	Absent	Absent	Low
California Ditaxis *Ditaxis californica*	C2	ND	List 1B R - 3 E - 2 D - 3	Moderate	High	High
Salton Milkvetch *Astragalus crotalariae*	ND	ND	List 4 R - 1 E - 1 D - 3	Absent	Low (KR < 250m)	Moderate
Sand-flat Locoweed *Astragalus insularis* var. *harwoodii*	ND	ND	List 2 R - 2 E - 2 D - 1	Absent	Low	Low
Borrego Milkvetch *Astragalus lentiginosus* var. *borreganus*	ND	ND	List 4 R - 1 E - 1 D - 1	Absent	Moderate (KR)	Moderate
Cove's Senna *Senna covesii*	ND	ND	List 2 R - 2 E - 2 D - 1	Low	Absent	Low
Orocopia Sage *Salvia greatae*	C2	ND	List 1B R - 2 E - 1 D - 3	Absent	Absent	Occurs

Table 3-1 Special-Status Plants and Plant Communities Reported from the Region						Page 3 of 3
Common Name ***Scientific name***	**[1]Federal status**	**[1]State status**	**[2]CNPS status**	**[3]Probability of occurrence**		
				Landfill site	**Access roads**	**Rail line**
Desert Unicorn Plant *Proboscidea althaeifolia*	ND	ND	List 4 R - 1 E - 1 D - 3	Moderate	Moderate	Occurs
Santa Ana Woolly-star *Eriastrum densifolium* ssp. *sanctorum*	FE	SE	List 1B R - 3 E - 3 D - 3	Absent	Absent	Absent
Slender-Horned Spineflower *Dodecahema [Centrostegia] leptoceras*	FE	SE	List 1B R - 3 E - 3 D - 3	Absent	Absent	Absent
Thurber's Pilostyles *Pilostyles thurberi*	C3C	ND	List 4 R - 1 E - 1 D - 1	Low	Low	Moderate
Las Animas Colubrina *Colubrina californica*	C3C	ND	List 4 R - 1 E - 1 D - 2	Moderate	Low	Moderate
Crucifixion Thorn *Castela emoryi*	ND	ND	List 2 R - 2 E - 1 D - 1	Moderate	Occurs (KR)	Occurs
Parish's Desert-thorn *Lycium parishii*	ND	ND	List 2 R - 2 E - 1 D - 1	Low	Low	Low

Table 3-2 Special-Status Fishes, Amphibians, and Reptiles Reported From the Region	Page 1 of 1

Common name ***Scientific name***	**[1]Federal status**	**[1]State status**	**[3]Probability of occurrence**		
			Landfill site	**Access roads**	**Rail line**
Desert Pupfish *Cyprinodon macularius*	FE	SE	Absent	Absent	Occurs
Desert Tortoise *Gopherus agassizii*	FT	ST	Occurs	Occurs (EM & KR)	Occurs
Common Chuckwalla *Sauromalus obesus*	C2	ND	Occurs	Occurs (EM)	Moderate
Colorado Desert Fringe-toed Lizard *Uma notata notata*	C2	CSC	Absent	Absent	Absent
Flat-tailed Horned Lizard *Phrynosoma mcallii*	FPT	CSC	Absent	Absent	Moderate
Banded Gila Monster *Heloderma suspectum cinctum*	C2	CSC	Absent	Absent	Absent

Table 3-3
Special-Status Bird Species Reported From the Region

Common name *Scientific name*	[1]Federal status	[1]State status	[3]Probability of Occurrence		
			Landfill site	Access roads	Rail line
California Brown Pelican *Pelecanus occidentalis californicus*	FE	SE, SA	Absent	Absent	Absent
White-tailed Kite *Elanus caeruleus*	ND	SA	Absent	Absent	Low
Bald Eagle *Haliaeetus leucocephalus*	FT	SE (nesting and wintering)	Absent	Absent	Absent
Northern Harrier *Circus cyaneus*	ND	CSC (nesting)	High (fall, winter)	High (fall, winter)	Occurs (fall, winter)
Sharp-shinned Hawk *Accipiter striatus*	ND	CSC (nesting)	High	Occurs (KR)	High
Cooper's Hawk *Accipiter cooperii*	ND	CSC (nesting)	High	High	High
Swainson's Hawk *Buteo swainsoni*	ND	ST (nesting)	Low (migr.)	Low (migr.)	Low (migr.)
Ferruginous Hawk *Buteo regalis*	C2	CSC (wintering)	Moderate (fall, winter)	Moderate (fall, winter)	Moderate (fall, winter)
Golden Eagle *Aquila chrysaetos*	ND	CSC (nesting and wintering)	High (forag.)	High (forag.)	High (forag.)
Merlin *Falco columbarius*	ND	CSC	Low (fall, winter)	Moderate (fall, winter)	Moderate (fall, winter)
Peregrine Falcon *Falco peregrinus*	FE	SE	Low (migrat.)	Low (migrat.)	Moderate (migrat.)
Prairie Falcon *Falco mexicanus*	ND	CSC (nesting)	High	High	High

Table 3-3
Special-Status Bird Species Reported From the Region

Common name *Scientific name*	[1]**Federal status**	[1]**State status**	[3]**Probability of Occurrence**		
			Landfill site	**Access roads**	**Rail line**
California Black Rail *Laterallus jamaicensis coturniculus*	C2	ST	Absent	Absent	Low
Yuma Clapper Rail *Rallus longirostris yumanensis*	FE	ST	Absent	Absent	Low
Western Snowy Plover *Charadrius alexandrinus nivosus*	C3C	CSC (breed-ing)	Absent	Absent	Moderate
Mountain Plover *Charadrius montanus*	C2	CSC (winter-ing)	Absent	Absent	Absent
Elf Owl *Micranthe whitneyi*	ND	SE (breed-ing)	Absent	Absent	Absent
Western Burrowing Owl *Speotyto cunicularia hypugea*	C2	CSC	Moderate	Moderate	Moderate
Long-eared Owl *Asio otus*	ND	CSC	Absent	Low (fall, winter)	Low (fall, winter)
Vaux's Swift *Chaetura vauxi*	ND	CSC	Moderate (migr.)	Moderate (migr.)	Moderate (migr.)
Gila Woodpecker *Centurus uropygialis*	ND	SE	Low (forag., migr.)	Low (forag., migr.)	Moderate (forag., migr.)
Southwestern Willow Flycatcher *Empidonax traillii extimus*	FPE	SE (breed-ing)	Low (migr.)	Low (migr.)	Low (migr.)
Purple Martin *Progne subis*	ND	CSC (nest-ing)	Low (migr.)	Low (migr.)	Low (migr.)
Eagle Mountain Scrub Jay *Aphelocoma coerulescens cana*	C2	CSC	Low	Absent	Absent

Table 3-3 Special-Status Bird Species Reported From the Region					Page 3 of 3
Common name ***Scientific name***	**[1]Federal status**	**[1]State status**	**[3]Probability of Occurrence**		
			Landfill site	**Access roads**	**Rail line**
Black-tailed Gnatcatcher *Polioptila melanura*	ND	SA	Occurs	Occurs (KR & EM)	Occurs
Bendire's Thrasher *Toxostoma bendirei*	ND	CSC	Moderate	Moderate	Moderate
Crissal Thrasher *Toxostoma crissale*	ND	CSC	Low	Low	Low
LeConte's Thrasher *Toxostoma lecontei*	C2	CSC	High	Occurs (KR & EM)	High
Loggerhead Shrike *Lanius ludovicianus*	ND	CSC	Occurs	Occurs (KR & EM)	High
Arizona Bell's Vireo *Vireo bellii arizonae*	ND	SE (nesting)	Absent	Absent	Absent
Least Bell's Vireo *Vireo bellii pusillus*	FE	SE (breeding)	Absent	Absent	Absent
Virginia Warbler *Vermivora virginiae*	ND	CSC	Low (migr.)	Low (migr.)	Low (migr.)
Yellow Warbler *Dendroica petechia*	ND	CSC (nesting)	Occurs (migr.)	High (migr.)	High (migr.)
Yellow-Breasted Chat *Icteria virens*	ND	CSC (nesting)	Occurs (migr.)	Low (migr.)	Moderate (migr.)
Tricolored Blackbird *Agelaius tricolor*	C2	CSC	Absent	Absent	Absent

Table 3-4 Special-Status Mammal Species Reported From the Region					Page 1 of 1
Common name ***Scientific name***	**[1]Federal status**	**[1]State status**	**[3]Probability of occurrence**		
			Landfill site	**Access roads**	**Rail line**
California Leaf-nosed Bat *Macrotis californicus*	C2	CSC	Occurs	High	High
Arizona Myotis *Myotis lucifugus occultus*	C2	CSC	Absent	Absent	Absent
Arizona Cave Myotis *Myotis velifer brevis*	C2	CSC	Absent	Absent	Absent
Spotted Bat *Euderma maculatum*	C2	CSC	Within range	Within range	Within range
Townsend's Big-eared Bat *Plecotus townsendii townsendii*	C2	CSC	Occurs	High	High
Pallid Bat *Antrozous pallidus*	ND	CSC	Occurs	High	High
Pocketed Free-tail Bat *Nyctinomops femorosaccus*	ND	CSC	Within range	Within range	Within range
California Mastiff Bat *Eumops perotis californicus*	C2	CSC	Within range	Within range	Within range
American Badger *Taxidea taxus*	ND	CSC	Occurs	Occurs (KR)	High
Yuma Mountain Lion *Felis concolor browni*	C2	CSC	Unknown	Unknown	Unknown
Nelson's Bighorn Sheep *Ovis canadensis nelsoni*	ND	SA	Occurs	Low	Occurs

[1] Federal and State status designations are taken from the Federal Register 50 CFR Part 17 Endangered and Threatened Wildlife and Plants; Animal Candidate Review for Listing as Endangered or Threatened Species; Proposed Rule (November 15, 1994), the Federal Register 50 CFR Part 17 Plant Taxa for Listing as Endangered and Threatened Species; Notice of Review (September 30, 1993), California Department of Fish and Game Natural Diversity Data Base, Special Animals (August 1994) and California Department of Fish and Game, Natural Heritage Division, Plant Conservation Program, Endangered, Threatened, and Rare Plants of California (June 1995).

[2] CNPS status is assigned only to plants by the California Native Plant Society (CNPS) (Skinner and Pavlik 1994).

[3] Probability of occurrence is the likelihood that a given species will occur on-site or within areas affected by the Project. For those species listed as "Occurs," the element has been detected by RECON and/or CMBC during surveys for this proposed Project. Occurrence probabilities are the likelihood that a given species will occur in a given year. Over the next 50 years, for example, nearly every one of the bird species listed in these tables is likely to occur within the Project area. Swainson's hawk, for example, has a low likelihood of occurrence for any one year, but is more than likely to occur within the Project area during the next 10 or 20 years. There is very little likelihood that species listed in these tables as "Absent" will ever occur, with the exception of migrant passerine birds, as described later in this report.

State and federal status definitions

Federal

FE	Listed endangered by the Service
FT	Listed threatened by the Service
FPE	Species that have either been proposed by the Service or petitioned by the public for federal listing as an Endangered Species
FPT	Species that have either been proposed by the Service or petitioned for federal listing as a Threatened Species
C2	Category 2 Candidate Species, for which information is currently being collected to see if the species should be listed as threatened or endangered.
C3C	Category 3 Species, which are too common and/or widespread to warrant listing at this time
ND	Species is not designated sensitive by one agency, but is considered to be sensitive by the other one
BLM	Considered sensitive by the Bureau of Land Management

State

SE	Listed endangered by Fish and Game Commission
ST	Listed threatened by Fish and Game Commission
CSC	California Species of Special Concern, which when encountered, should be reported to the Department, and for which impacts may be considered significant under the California Environmental Quality Act, depending on the specific situation
SA	Special Animal, which is an animal fully protected by the state
CHIP	Designated a Community of Highest Inventory Priority (CHIP) by the state, which implies importance but does not result in protection
ND	Species is not designated sensitive by one agency, but is considered to be sensitive by another one

California Native Plant Society status definitions

List 1B	Plants rare, threatened, or endangered in California and elsewhere
List 2	Plants rare, threatened, or endangered in California but more common elsewhere
List 3	Plants about which more information is needed; a review list
List 4	Plants of limited distribution; a watch list
R - 1	(R = Rarity) Rare, but found in sufficient numbers and distributed widely enough that the potential for extinction is low at this time
R - 2	Distributed in a limited number of occurrences, occasionally more if each occurrence is small
R - 3	Distributed in one to several highly restricted occurrences, or present in such small numbers that it is seldom reported
E - 1	(E = Endangerment) Not endangered
E - 2	Endangered in a portion of its range
E - 3	Endangered throughout its range
D - 1	(D = Distribution) More or less widespread outside California
D - 2	Rare outside California
D - 3	Endemic to California

Probability of occurrence definitions (PLANTS)

Occurs	Observed during our winter 1995 surveys or during RECON's earlier surveys.
High	The species is commonly reported from the area, has been observed in adjacent regions, occurs in the same habitat type as found on-site.
Moderate	The habitat on-site is the type used by the species but the site is peripheral to or out of its functional range, or the species was not detected during surveys, but may have been missed due to an inconspicuous appearance, or may only germinate when specific conditions are met; the species would be expected on-site or in the vicinity at least, every several years.
Low	The species is rarely reported from the area, or only historically, and the habitat type is occasionally but not primarily that in which the species is found; the species may occur in limited areas of suitable habitat; or the species was not detected during surveys of the area, and would likely have been detected if present, e.g., a perennial or large-sized plant.
Absent	Habitat required by the species is absent; or, if there is suitable habitat, the Project site is sufficiently isolated from known populations that there is no, or very little likelihood that the species would occur in the area; or surveys did not detect the species, and were complete enough to ensure that if the species was present it would have been detected.
Unknown	Insufficient information was found to determine if the species occurs within the Project area at this time.

Probability of occurrence definitions (ANIMALS)

Occurs	Observed during our winter 1995 surveys or during RECON's earlier surveys.
High	The species is commonly reported from the area, has been observed in adjacent regions, occurs in the same habitat type as found on-site, and may with some certainty be observed at most, daily, and at least, yearly, within the Project area.
Moderate	The habitat on-site is the type used by the species but the site is peripheral to or out of its functional range, or the species is a migrant that may incidentally be found within the Project area; the species would be expected on-site or in the vicinity at least, every several years, and at most, monthly, particularly during the migratory season for applicable species.
Low	The species is rarely reported from the area, or only historically, and the habitat type is occasionally but not often used by the species; the species may either occur in limited areas of suitable habitat, or be solely incidental to the site during the migratory period.
Absent	Habitat required by the species is absent; or, if there is suitable habitat, the Project site is sufficiently isolated from known populations that there is no, or very little, likelihood that the species would immigrate into the area; in the case of migratory passerines, the sites may be within the flyway and the birds may stop to rest or forage, but they would not remain on-site or in the area for more than a few hours or days.
Within Range	The site is within the known range of the species, but the actual likelihood of occurrence is unknown at this time (e.g., bat species).
Unknown	Insufficient information was found to determine if the species occurs within the Project area at this time.

Life histories and records of special-status species. The previous tables list all special-status elements reported from the area. In this section CMBC lists only those elements that have been (1) detected in field surveys, (2) have a high likelihood of occurrence, (3) have been identified during scoping or previous environmental documents as a concern, and/or (4) are expected to be directly or indirectly impacted by the proposed Project. Information concerning the life history of these species and records of occurrence in the local area are presented below. Appendix C. provides life history information and likelihood of occurrence for elements not likely to be significantly impacted by the Project.

Plants.

Foxtail Cactus *(Escobaria vivipara var. alversonii)*
Status: Federal Category 2 Candidate/ State None/ CNPS List 1B, RED = 2-2-2
Life History: This rare cactus is found in sandy or rocky areas of creosote bush scrub at elevations between 75 and 600 m (Hickman 1993). Munz (1974) gives a slightly different distribution, on stony slopes in creosote bush, or Joshua tree woodland, at elevations from 600 to 1,525 m from the Little San Bernardino Mountains to the Eagle and Chuckwalla Mountains. The plant blooms from May to June. Threats to the plant include horticultural collecting (Skinner and Pavlik 1994).

Records and Likelihood of Occurrence: The Natural Diversity Data Base reports two occurrences from the Desert Center quadrangle, one from the Hayfield Spring quadrangle, and one from the Victory Pass quadrangle (California Department of Fish and Game 1994d). This plant was observed in all three parts of the Project area during CMBC's 1995 surveys and RECON's 1989 surveys (RECON 1991).

California Barrel Cactus *(Ferocactus cylindricus* var. *cylindricus)*
Status: Federal BLM/ State None/ CNPS None
Life History: California barrel cactus is found in gravelly or rocky places in the California desert below 600 m. This species is considered sensitive by the Bureau, although it is not currently given special status by the Service, Department, or CNPS.

Records and Likelihood of Occurrence: RECON located over 800 barrel cactus within the proposed landfill site. Additional plants were observed by RECON and CMBC near access roads and along the rail line. Locations of some of these plants are given in Figure g.

California Ditaxis *(Ditaxis californica)*
Status: Federal Candidate 2/ State None/ CNPS List 1B, RED = 3-2-3
Life History: This perennial species is found in washes and canyons in the Mojave and northwest Sonoran Deserts from 50 to 1,000 m in elevation (Hickman 1993). Munz (1974) reports the species from 130 to 1,000 m in sandy washes in creosote bush scrub, from the Santa Rosa Mountains to the south side of the Eagle Mountains. It blooms from March to May and October to December (Munz 1974). The CNPS Inventory (Skinner and Pavlik 1994) reports that the plant is known from fewer than 20 locations in California. Threats to the species include off-highway vehicles.

Records and Likelihood of Occurrence: The Data Base (California Department of Fish and Game 1994d) reports two occurrences (1984 and 1976) from the Hayfield quadrangle, one (1930) from the Desert Center quadrangle, one (1956) from the Victory Pass quadrangle, and one (1986) from the Hayfield Spring quadrangle. Peter Woodman (pers. comm., May 1995) found this species along Southern California Edison electric lines on the Chuckwalla Bench, approximately 8.0 km (five miles) west of Eagle Mountain Road and 11.3 km (seven miles) west of Desert Center. The Bureau reports the species at a location 6.5 km (four miles) north of the northern boundary of the Chuckwalla Bench ACEC (USDI Bureau of Land Management undated). Individuals of other *Ditaxis* species were located near Eagle Mountain Road by RECON and during CMBC's 1995 surveys. Given the large size (1.5 to 5 dm) and perennial habit of the species, California ditaxis should have been detected during surveys if present. Appropriate habitat is present however, and the plant could occur off survey routes. California ditaxis is therefore considered to have a moderate likelihood of occurrence on the proposed site and a high likelihood of occurrence along the access road and rail line.

Orocopia Sage *(Salvia greatae)*

Status: Federal Category 2 Candidate/ State None/ CNPS List 1B, RED = 2-1-3

Life History: This evergreen shrub of the mint family is found in creosote bush scrub, in dry washes, and on alluvial fans below 180 m. It blooms from March to April and is known from the Orocopia Mountains to the Chocolate Mountains, in Riverside County (Munz 1974). The Jepson Manual (Hickman 1993) reports the species from 30 to 240 m on alluvial slopes. Skinner and Pavlik (1994) list locations in Imperial, Riverside, and San Bernardino Counties. They consider the record from San Bernardino County questionable.

Records and Likelihood of Occurrence: The Data Base (California Department of Fish and Game 1994d) reports eight locations (seven in 1986, one in 1926) from the Red Canyon quadrangle, and three (undated) from the Frink NW quadrangle. The closest of these are directly adjacent to the rail line. Populations along the rail line were verified by RECON's 1989 surveys. The proposed landfill site and access roads are north of the species' known range and at higher elevations than those typical for the species. For these reasons and because it was not found, Orocopia sage is considered absent from the proposed landfill site and access road.

Desert Unicorn Plant *(Proboscidea althaeifolia)*

Status: Federal None/ State None/ CNPS List 4, RED = 1-1-3

Life History: Desert unicorn plant is a perennial species of the Martyniaceae family found below 1,000 m in sandy locations in the Sonoran [Colorado] Desert in California (Hickman 1993). It blooms from May to August.

Records and Likelihood of Occurrence: This species was observed by RECON along the rail line. It has a moderate likelihood of occurrence on the proposed landfill site and along access roads, since appropriate habitat is present, but the plant was not detected during surveys.

Crucifixion Thorn *(Castela emoryi)*

Status: Federal None/ State None/ CNPS List 2, RED = 2-1-1

Life History: This thorny, deciduous shrub from the figwort family is found in dry, gravelly palaces in creosote bush scrub, in the southern Mojave Desert and Colorado Desert. Crucifixion thorn is also found in Arizona and northwest Mexico. It blooms from June to July (Munz 1974). Hickman (1993) reports the species from elevations around 700 m.

Records and Likelihood of Occurrence: Crucifixion thorn is reported in the Data Base (California Department of Fish and Game 1994d) from one location (1986) on the Hayfield Spring quadrangle, approximately 0.8 km (0.5 miles) from the pumping station. While the species is fairly common outside of California, it is a CNPS List 2 species, and it is mandatory that effects to the species be considered under CEQA. This species was located within 61 m of the rail line by RECON, and in 1995 by Peter Woodman during CMBC's surveys near Kaiser Road, north of Lake Tamarisk (Figure i.). Appropriate habitat occurs within the proposed landfill site, though no shrubs of this species have been observed during surveys of the area. Thus crucifixion thorn is considered to have a moderate probability of occurrence on the proposed landfill site.

Fish, amphibians, and reptiles.

Desert Pupfish *(Cyprinodon macularius)*

Status: Federal Endangered/ California Endangered

Life History: The desert pupfish is an inhabitant of isolated desert water sources, such as seeps, springs, marshes, and saline pools. Soft-bottomed, still pools, less than 0.6 m deep are ideal habitat. These small fish can tolerate very low oxygen, salinity levels up to twice that of ocean water, and extremely warm temperatures, up to 45 °C(113 °F). These fish are territorial during breeding, with males defending an area of approximately 1-2 m^2, often centered on a submerged object. This species spawns between April and October, when water temperatures exceed 20 °C(68 °F). The eggs hatch roughly 10 days after fertilization.

Larvae begin feeding the day after hatching. Desert pupfish feed opportunistically, on such items as aquatic insects, crustaceans, copepods, vegetation, and snails. They may even eat their own eggs or young. Factors that have led to the species decline include draining of wetlands, introduction of non-native fishes that compete with and prey upon the pupfish, groundwater pumping, development, and pesticides (Thelander and Crabtree 1994). Populations of desert pupfish fluctuate greatly between seasons and years. These fish migrate in response to changing water levels, moving to areas that maintain water in dry periods, as smaller pools dry up.

Records and Likelihood of Occurrence: Desert pupfish have been reported in the Data Base from Salt Creek, and from two artificial refugia: Oasis Spring and Rancho Dos Palmas (California Department of Fish and Game 1994d). As described in RECON's technical report (1991), a population of this fish was located during surveys by the Department in 1990, approximately 0.4 km (one-quarter mile south of the Eagle Mountain railroad trestle in a tributary of Salt Creek, and appropriate habitat exists at the trestle site (RECON 1994a). This population was estimated at 125 fish in early June of 1990, but was decimated by a flash flood that reduced the population to two individuals by June 16, 1990. On 6 August 1993 during water quality sampling, fish believed to be desert pupfish were observed by RECON within 30 m of the trestle. Earlier surveys report that the species was present throughout Salt Creek, and the Bureau's Management Plan for the Salt Creek Desert Pupfish/Rail Habitat ACEC indicates that the best pupfish habitat in the area begins approximately one mile below the railroad trestle and extends upstream to the headwaters of the tributary (USDI Bureau of Land Management 1982). RECON (1991) identifies this tributary as a potential movement corridor for desert pupfish upstream and downstream from the railroad crossing.

Desert Tortoise *(Gopherus agassizii)*
Status: Federal Threatened/ California Threatened

Life History: This species inhabits desert scrub, desert wash habitats, and Joshua tree woodland (Zeiner et al. 1988). Tortoises feed primarily on spring annual grasses and forbs as well as perennial grasses. They are most active in the spring and fall months, and escape extreme temperatures of summer and winter by remaining in underground burrows, hibernating in the winter months. Desert tortoises breed and produce eggs most often in spring, although fall mating also occurs. Female tortoises lay between two and nine eggs, typically five. Eggs are buried in a nest, often in the soil near the entrance to a burrow. Home range sizes are estimated to be between 11 and 53 hectares (Berry et al. 1986). Tortoises are detected by burrow openings, scat (droppings), carcasses, and other sign.

Records and Likelihood of Occurrence: The Data Base reports occurrences of desert tortoise at the southwest base of the Coxcomb Mountains and at the base of Eagle Mountains approximately 9.7 km (six miles) northwest of Desert Center, as well as throughout the Chuckwalla Bench and south Pinto Basin. The Chuckwalla Bench has the highest density desert tortoise population in the Colorado Desert, estimated at 279 tortoises per square mile (259 hectares) on the permanent study plot located on the Bench (Berry et al. 1983). However areas of high tortoise density may be patchy on the Chuckwalla Bench, with "relatively small islands of high density" (USDI Bureau of Land Management undated). Densities in the Orocopia Mountains Wilderness are lower, estimated at between 20 to 50 per square mile, and variable in the Chuckwalla Mountains Wilderness (20 to 50, 50 to 100, and 100 to 250 per square mile in different locations) (USDI Bureau of Land Management 1980a, Figure j.). RECON's (1991) report maps Category 1 and Category 3 Habitat areas for desert tortoise in the vicinity of the planned Project. The management categories include the highest and lowest priorities, respectively, for maintaining viable tortoise populations. The rail line and parts of Eagle Mountain Road cut through the Chuckwalla Unit of Critical Habitat and Chuckwalla Desert Wildlife Management Area (DWMA) (Figure f.) for desert tortoise (USDI Fish and Wildlife Service 1994a).

Tortoise sign found to date on the proposed landfill site and adjacent areas (Figure h.), along Eagle Mountain and Kaiser Roads (Figure i.), and along the rail line (RECON 1991) are summarized in Table 3-5. The amount of sign should not be considered an indicator of relative tortoise densities, since unequal amounts of effort and area, and differences in vegetation and terrain, influence the amount of sign located.

Table 3-5. Tortoise Sign Located During Project Surveys

Site	Tortoise Sign				Survey
	Scat	Burrow	Carcass	Tortoise	
Rail line	27 N/A	104 N/A	9 N/A	7 1	RECON CMBC
Landfill & vicinity	0 6	2 7	0 2	0 2	RECON CMBC
Kaiser Rd.	N/A 3	N/A 5	N/A 1	N/A 0	RECON CMBC
Eagle Mtn. Road	3 7	4 10	1 0	0 2	RECON CMBC

Tortoises were also observed during RECON's 1993 monitoring and radio telemetry work. Twenty-seven adult female tortoises were individually marked and equipped with radio transmitters in the course of the telemetry study. Eight of these were located north of I-10 in the Eagle Mountain study area, and 19 in the Chuckwalla Bench study area north of the Chocolate Mountains and south of I-10. Ten adult females smaller than 200 mm carapace length, 14 juvenile tortoises, and 38 adult males were also observed during this work, and individually marked, but not fitted with transmitters. During 1993, while RECON monitored 11 train trips on the rail line, 23 tortoises were removed from the railroad berm or tracks. Most of these animals were previously marked from the radio telemetry study. None of the animals observed during monitoring and telemetry work showed symptoms of respiratory or shell disease (RECON 1994a).

Common Chuckwalla *(Sauromalus obesus)*
Status: Federal Category 2 Candidate/ State None

Life History: Chuckwallas inhabit a variety of habitats in the Mojave and Colorado Deserts. They are most abundant in creosote bush scrub, and are found only in areas with large rocks, boulders, or rocky outcrops, usually on slopes. Chuckwallas feed entirely on plant material, especially the flowers, leaves, and fruits of creosote bush. This species lays eggs in nests dug in sandy, well-drained soils. Breeding occurs from April to June, peaking in late April to May. Eight eggs make up an average clutch, though clutch size ranges from 6 to 13. A female produces only one clutch in two or three years. Chuckwallas are generally active only from mid-spring to mid-summer, and occasionally in fall, though they can be active year-round in warm areas. Densities of about 23 chuckwallas per hectare ($\approx$ 9 per acre) have been documented for the area (Abst 1987). Threats to the species may include predation by ravens (Boarman and Berry in prep.), habitat loss, and collecting.

Records and Likelihood of Occurrence: Chuckwallas were detected by CMBC during surveys of the proposed landfill site and near Eagle Mountain Road. The species is considered to have a moderate likelihood of occurrence along the rail line, since it is restricted to rock outcrops, which are found at only scattered locations near the rail line.

Flat-tailed Horned Lizard *(Phrynosoma mcallii)*
Status: Federal Proposed Threatened/ California Species of Special Concern
Life History: The flat-tailed horned lizard is found in areas of fine sand in desert habitats in central Riverside, eastern San Diego, and Imperial Counties. Suitable sands are generally found in washes or desert flats, in creosote bush scrub, saltbush scrub, and succulent scrub. Flat-tailed horned lizards feed primarily on ants, as do other horned lizards. Some arthropods may also be eaten. These lizards require fine sand substrates; they burrow below the surface of the sand to escape extreme temperatures. They also use shrubs and clumps of grass for thermal cover, climbing into these plants when the soil surface may be very hot. Flat-tailed horned lizards are most active in the spring, early summer, and fall, but they can be found above ground any time of year when temperatures are mild. This species is thought to breed in the early spring. The average number of eggs laid is five, and more than one clutch per year may be produced under favorable conditions. Home ranges have been documented between 0.02 to 0.21 hectares, with males ranging further than females. Flat-tailed horned lizards are not thought to be territorial. Predators probably include shrikes, roadrunners, falcons, ravens, foxes, and coyotes. Threats to the species are habitat loss to development and recreation, such as off-highway vehicle use (Zeiner et al. 1988).

Records and Likelihood of Occurrence: The closest Data Base records for this species to the Project areas are near the Salton Sea (Figure l.). One record is within 1.6 km (one mile) of the rail line. RECON detected horned lizard scat along the rail line in several locations north and south of Interstate 10. Given the location, these scat are likely those of desert horned lizard. Flat-tailed horned lizard is considered absent from the proposed landfill site and access roads, with a moderate likelihood of occurrence near the southern terminus of the rail line.

Birds.

Northern Harrier *(Circus cyaneus)*
Status: Federal None/ California Species of Special Concern
Life History: Northern Harriers are found in a variety of open habitats, from meadows to desert sinks. Wetlands are preferred. Prey is small mammals. This species nests on the ground, often at the edge of a marsh, in shrubs. Breeding pairs and juveniles may roost together in the autumn and winter months. Destruction of native habitats, especially wetlands, meadows, and native grasslands, have harmed this species (Zeiner et al. 1990a).

Records and Likelihood of Occurrence: The Project site is within the winter range of the species and habitat on the proposed landfill site, near the rail line, and near access roads may be appropriate for foraging. Areas on the rail line near the Salton Sea and where wetlands are present are especially suitable. One Northern Harrier was observed in desert wash habitat north of I-10, near the rail line, during RECON's 1989-1990 surveys. Thus the species is considered to occur on the rail line, and have a high likelihood of occurrence on the other two portions of the Project area.

Sharp-shinned Hawk *(Accipiter striatus)*
Status: Federal None/ California Species of Special Concern
Life History: This small accipiter is a winter resident in all California habitats except those with deep snow, open prairie, and bare desert. Sharp-shinned Hawks breed in forested areas, including mixed conifer, ponderosa and Jeffrey pines, black oak, and especially riparian woodlands. They feed on small birds for the most part, also taking occasional reptiles, amphibians, small mammals, and insects. Home range, including foraging area, has been reported at approximately 2,670 hectares (Zeiner et al. 1990a).

Records and Likelihood of Occurrence: The Project area is outside of the breeding range for this species, but migrants are likely to occur in the fall and spring months, and Sharp-shinned Hawks may winter in any of the three Project areas, especially where riparian vegetation is present. One Sharp-shinned Hawk was observed in February 1995 along Kaiser Road near Lake Tamarisk during CMBC's surveys (Figure i.). There is a high likelihood of occurrence at the proposed landfill site and along the rail line.

Cooper's Hawk *(Accipiter cooperii)*
Status: Federal None/ California Species of Special Concern

Life History: Cooper's Hawks are breeding residents of woodlands throughout California. Dense riparian areas, live oak stands, and other forested habitats near water are preferred, although Cooper's Hawks may be observed in residential areas, even hunting at backyard bird feeders. This species feeds primarily on small birds, but may also take small mammals, reptiles, and amphibians. It nests in deciduous trees or conifers, usually in riparian areas or in second-growth conifer forests near streams. Breeding takes place from March to August, especially May to July. The female incubates the eggs for 35-65 days. Males defend territories with a radius of about 100 m centered on the nest site during pair formation. Home ranges have been measured at 7-215 hectares (Zeiner et al. 1990a).

Records and Likelihood of Occurrence: Most parts of the Project area are within the year-round range for the Cooper's Hawk, although the central part of the rail line passes through an area of winter-range only (Zeiner et al. 1990a). This species has a high likelihood of occurrence in all Project areas.

Golden Eagle *(Aquila chrysaetos)*
Status: Federal None/ California Species of Special Concern

Life History: Golden Eagles inhabit open habitats including desert scrub. Prey species include rabbits, hares, and rodents. They nest on cliffs of all heights and in large trees in open areas. In southern California Golden Eagles may occupy territories up to 6,638 hectares (36 square miles) (Dixon 1937). Golden Eagles breed from late January to August, especially March to July. Clutch sizes range from one to three, average two. Incubation is 43-45 days, and eggs are generally laid from February to mid-May. The young typically fledge at 65-70 days (Zeiner et al. 1990a). Threats to the species are primarily related to habitat loss to development, and disturbance at nest sites leading to nest failure or abandonment. Egg shell thinning due to pesticide (DDE) poisoning has also affected this species.

Records and Likelihood of Occurrence: Golden Eagles are likely to occur throughout the Project area, since suitable foraging habitat is present in all areas supporting native vegetation. Suitable nest sites are present in nearby mountainous areas, and roosting and perch sites are available on the proposed landfill site.

Prairie Falcon *(Falco mexicanus)*
Status: Federal None/ California Species of Special Concern

Life History: This falcon nests on sheltered cliff ledges and forages over open habitats including desert scrub, grasslands, savannahs, and croplands. It hunts small mammals, birds, and reptiles. Nesting takes place from mid-February to mid-September, especially March to May in California. The period of incubation is 29-33 days (Snow 1974), and the average clutch size is five eggs (range three to six). Home ranges for this bird are unusually large in relation to its body size, and in the Mojave Desert average 5,940 hectares (males 7,190 hectares, females 4,660 hectares) (Harmata et al. 1978) . Threats to this species include habitat loss, pesticide (DDE) poisoning, disturbance at nest sites, and collecting of young for falconry (Zeiner et al. 1990a).

Records and Likelihood of Occurrence: This species was reported from the Hayfield, Hayfield Spring, Red Canyon, Desert Center, and Durmid quadrangles by the California Natural Diversity Data Base (California Department of Fish and Game 1994d). Prairie Falcon eyeries (cliff nest sites) are reported from the Orocopia and Chuckwalla Mountains (USDI Bureau of Land Management 1980a). No Prairie Falcons were observed during surveys of the sites by RECON or by CMBC. Appropriate foraging habitat is present in all areas and suitable nesting sites are likely to occur in nearby mountainous areas. The species is considered to have a high likelihood of occurrence throughout the Project area.

Western Burrowing Owl *(Speotyto cunicularia hypugea)*

Status: Federal Category 2 Candidate Species/ California Species of Special Concern

Life History: This owl is a year-round resident of desert scrub and other open habitats. It preys on insects, small mammals, reptiles, amphibians, birds, and carrion. These owls use burrows for nesting and roosting cover. These burrows may be originally excavated and occupied by ground squirrels or other rodents, badgers, skunks, desert tortoise, or other burrowing animals, and modified by the owls for their own use. Nesting occurs in an enlarged chamber at the end of the burrow (Zarn 1974). Burrowing Owls form pairs in winter or early spring, and eggs are laid mainly from mid-March to early May, though breeding may extend through the summer months (Zarn 1974, Zeiner et al. 1990a). The number of eggs in a clutch varies from six to eleven, averaging seven to nine. The female incubates the eggs and is fed by the male during incubation. Incubation takes approximately four weeks. Young owls remain in the burrow until about two weeks old, when they come to the burrow's entrance and wait for the adults to bring food. They learn to fly by about the age of four weeks. They can fly well by about six weeks, but remain within about 50 m of the burrow entrance (Zarn 1974). Predators include Prairie Falcons, Swainson's Hawks, Red-tailed Hawks, Northern Harriers, Ferruginous Hawks, Golden Eagles, coyotes, and foxes. Primary threats to this species include habitat loss, indirect poisoning (through ingesting poisoned prey), predation by domestic animals, and collisions with automobiles (Zeiner et al. 1990a).

Records and Likelihood of Occurrence: Burrowing Owls were not observed in surveys of the Project areas by RECON or by CMBC. However suitable habitat is present in all Project areas that are relatively level and less rocky; i.e., along the rail line, access roads, and on the southern and eastern portions of the proposed landfill. As such, CMBC considers the species to have a moderate likelihood of occurrence in these areas.

Long-eared Owl *(Asio otus)*

Status: Federal None/ California Species of Special Concern

Life History: Long-eared Owls are residents and winter visitors to most habitats in the state, except the North Coast Range, Cascades, and high elevation Sierra Nevadas. They are typically found in riparian or live oak thickets near meadow edges, or nearby forests and woodlands. They feed on small mammals such as voles, occasionally on birds, and other vertebrates. Riparian habitat or other thickets with dense canopied trees, such as live oak stands, are needed for roosting. This species has declined in response to loss of riparian and live oak habitats (Zeiner et al. 1990a).

Records and Likelihood of Occurrence: The Project areas are within the winter range for the species. Appropriate nesting habitat for Long-eared Owls is not present within the proposed landfill site. Marginal foraging habitat may be present near the access roads in washes and near Lake Tamarisk, and in similar circumstances along the rail line. Thus the species is considered absent from the site and has a low likelihood of occurrence near access roads and the rail line.

Eagle Mountain Scrub Jay *(Aphelocoma coerulescens cana)*

Status: Federal Category 2 Candidate/ California Species of Special Concern

Life History: Eagle Mountain Scrub Jays are endemic to pinyon-juniper woodland and scrub oak habitats above 1,200 m in parts of the Little San Bernardino Mountains, including Eagle Mountain, within Joshua Tree National Park (Pitelka 1951, Miller and Stebbins 1964). The population is considered to have originated by hybridization between coastal and interior populations of Scrub Jays (Peterson 1990). Scrub Jays are omnivorous, feeding primarily on acorns and nuts, as well as fruits, seeds, insects and other invertebrates, caching food in the soil (Zeiner et al. 1990), or tree bark. Eagle Mountain Scrub Jays nest beginning in early April (Miller and Stebbins 1964). Scrub Jays in other areas begin nesting in early March, continuing through mid-August. Clutch sizes range from two to six, with an average of two to three. The period of incubation is between 15 and 18 days, and young fledge at 18 to 23 days. Pairs of Scrub Jays defend a joint territory throughout the year, with reported sizes of about two to three hectares. Predators include hawks, small mammals, and ravens.

Records and Likelihood of Occurrence: Eagle Mountain Scrub Jays were not observed during surveys of the Project areas by RECON or by CMBC. No pinyon-juniper or scrub oak woodland habitat occurs in any of the Project areas, and the main area occupied by this species is approximately 29.0 km (18 miles) from the proposed landfill site (RECON 1991). Thus Eagle Mountain Scrub Jays are considered absent from the vicinity of access roads and the rail line, and have only a low likelihood of occurrence on the site, perhaps as dispersing subadults.

Black-tailed Gnatcatcher *(Polioptila melanura)*
Status: Federal None/ California Special Animal
Life History: Preferred habitat for this species is desert wash, but these birds also occur in desert scrub. Black-tailed Gnatcatchers are absent in habitats heavily invaded by tamarisk. This bird feeds on insects and spiders, and nests in shrubs 0.6 to 0.9 m above ground level. The breeding season for Black-tailed Gnatcatchers peaks in April and May. Four eggs are laid in an average clutch, and these are incubated by both sexes, for a period of 14-15 days. The young mature quickly and fledge at age 9-10 days. Threats include habitat loss and cowbird parasitism (Zeiner et al. 1990a).

Records and Likelihood of Occurrence: Black-tailed Gnatcatchers were observed by RECON at several locations along the rail line, and by CMBC near Kaiser and Eagle Mountain Roads and on the proposed landfill site.

LeConte's Thrasher *(Toxostoma lecontei)*
Status: Federal Category 2 Candidate/ California Species of Special Concern
Life History: This species is a year-round resident of a variety of desert habitats, including creosote bush scrub, saltbush scrub, and Joshua tree woodland. It feeds on insects and other terrestrial arthropods, and occasionally on seeds, small lizards, and other small vertebrates. The nesting season for this bird extends from January to early June, with a peak in breeding activity between mid-March and mid-April. Two to four eggs (usually three) are laid in a clutch, and two to three clutches may be produced in one year. The incubation period is 14-20 days, and the young fledge at 14-18 days. LeConte's thrashers nest in dense, spiny shrubs or densely branched cactus. This species is particularly wary of humans. Threats to this species include disturbance from off-highway vehicles and other human activity, and habitat loss from agriculture and development (Zeiner et al. 1990a).

Records and Likelihood of Occurrence: This species has a high likelihood of occurrence in the proposed landfill area and along the rail line, especially in areas of dense spiny shrubs and Joshua tree woodland. LeConte's thrashers were observed during CMBC's 1995 surveys near Kaiser and Eagle Mountain Roads.

Loggerhead Shrike *(Lanius ludovicianus)*
Status: Federal None/California Species of Special Concern
Life History: Loggerhead Shrikes are open-country birds, found in a variety of habitats from hardwood savannahs to Joshua tree woodland and desert riparian. Scattered perch sites such as fence posts, shrubs, utility lines, and trees are important habitat components. Shrikes feed primarily on large insects, also small mammals, birds, amphibians and reptiles, fish, carrion, and other invertebrates. Loggerhead Shrikes are known for caching their prey on thorns, barbed wire, and sharp twigs. They breed from March to May, laying clutch of four to eight eggs in a well-concealed nest in a tree or shrub. Incubation takes place over a 14-15 day period. Fledging takes 18-19 days. Territories are defended year round, averaging over 7 hectares in one study. Threats to this species include pesticide (DDE) poisoning, and nest predation by magpies (Zeiner et al. 1990a).

Records and Likelihood of Occurrence: Loggerhead Shrikes were observed by CMBC near Kaiser and Eagle Mountain Roads and within the proposed landfill site, and by RECON (location not given). They most likely occur along the rail line, since suitable foraging and breeding habitat is present.

Yellow Warbler *(Dendroica petechia)*
Status: Federal None/ California Species of Special Concern

Life History: Yellow Warblers are summer residents and breeders in riparian woodlands, montane chaparral, open ponderosa pine, and mixed conifer habitats with a brushy understory. They feed on insects and spiders, and occasionally berries. Brown-headed Cowbird nest parasitism has contributed to the species reduced numbers (Zeiner et al. 1990a).

Records and Likelihood of Occurrence: Yellow Warblers likely migrate through all portions of the Project area, especially where wash and riparian associated habitat is present. Two were observed during Brown's (1990) bat surveys at the reservoir in the Townsite. The Bureau's draft management plan for the Chuckwalla Bench reports that Yellow Warblers have been recorded in wash areas of the ACEC (USDI Bureau of Land Management undated). Thus the species occurs on the proposed landfill site as a migrant, and is given a high likelihood of occurrence during migration along access roads and the rail line.

Yellow-breasted Chat *(Icteria virens)*
Status: Federal None/ California Species of Special Concern

Life History: Yellow-breasted Chats breed and migrate through coastal California and the foothills of the Sierra Nevada. Breeding in southern California is coastal, and very locally inland. This species uses thick clumps of brush or willows, usually in riparian areas. It feeds on insects, spiders, berries, and other fruits (Zeiner et al. 1990a).

Records and Likelihood of Occurrence: One individual of this species was observed within the Townsite during Brown's (1990) bat surveys. Yellow-breasted Chats may be expected as migrants near the access roads and rail line. The species is given a low likelihood of occurrence along the access road, and a moderate likelihood of occurrence along Salt Creek.

Mammals.

California Leaf-nosed Bat *(Macrotis californicus)*
Status: Federal Category 2 Candidate/ California Species of Special Concern

Life History: California leaf-nosed bats are found in Riverside, San Bernardino, San Diego, and Imperial Counties in California. Habitats in which leaf-nosed bats are presently found include desert scrub, desert wash, desert riparian, desert succulent scrub, alkali desert scrub, and palm oasis, below about 600 m (Zeiner et. al. 1990b). Coastal populations have disappeared, and desert populations have declined in numbers, although large populations persist near the Colorado River. These bats feed on flying and flightless insects, such as cicadas, moths, and beetles. Deep mine tunnels which provide a buffer from hot desert temperatures are used for roosting during the day. Rugged, rocky terrain with mines and caves is typical of occupied habitat for this species.

Records and Likelihood of Occurrence: Dr. Patricia Brown's 1990 survey for bat species at the existing mine detected a population of approximately 60 leaf-nosed bats in a chamber of the Kaiser Eagle Mountain Mine. The chamber is apparently used as a winter day roost, and it is estimated that at least 100 bats of this species use this roost. A pregnant female was also captured, indicating that the site may also be a maternity roost (Brown 1991). Another maternity roost occurs at the Lucky Turkey #2 mine, on Joshua Tree National Park (Brown pers. comm., August 21, 1995). Moth wings and guano at the entrance of the Kaiser Eagle Mountain Mine suggest that the entrance may be used as a night roost.

Night roosts for the species were also located in two metal culverts just west of the main mill site and in a concrete structure built into a hill near the mine entrance (Figure h.). Brown states that the culverts may also be used as day roosts during certain times of the year (Brown 1990). Two leaf-nosed bats were observed exiting the Black Eagle Mine during winter surveys (Brown 1990). There is a high likelihood that leaf-nosed bats forage along the access roads and along the rail line, given the proximity to known roost sites.

During Brown's 1992 and 1993 winter surveys, 23 leaf-nosed bats were observed exiting Kaiser Mine on December 16, 1992, and 25 individuals were observed exiting Black Eagle Mine the following evening. The evening of January 17, 1993, 59 leaf-nosed bats were seen leaving the Kaiser Mine adit, and none left the Black Eagle Mine. In summer surveys (June 24-26, 1993) up to 10 leaf-nosed bats were observed at Kaiser Mine, and none at Black Eagle Mine (Brown 1993). She observed 79 individuals exiting the mine on the evening of January 18, 1996.

Dr. Brown states that the primary importance of the Kaiser Mine is as a winter roost for leaf-nosed bats, since no other winter roosts have been located during air searches over the Orocopia, Chuckwalla, and Coxcomb Mountains (Brown pers. comm., August 21, 1995). Only about 10 mine sites are known in southern California that provide winter roosts for this species (Brown as cited in RECON 1992).

Townsend's Big-eared Bat *(Plecotus townsendii townsendii)*
Status: Federal Category 2 Candidate/ California Species of Special Concern
Life History: This species was once considered common in all habitats in California except alpine and subalpine areas. It was most abundant in mesic habitats. Townsend's big-eared bats feed primarily on moths, and require caves, mines, tunnels and buildings for roost sites. Maternity roosts are usually located in warm sites, while hibernacula are cold, but not below freezing (Zeiner et al. 1990b). This species is especially susceptible to human disturbance, and may abandon roost sites if disturbed.

Records and Likelihood of Occurrence: Guano of this species was observed in Eagle Mountain Mine during Brown's 1990 surveys, indicating a possible maternity roost (Brown•1990). No bats of this species or more recent sign were observed, possibly indicating that the roost has been abandoned. If the species is present, it is likely to forage in nearby areas, including near access roads and the rail line.

Pallid bat *(Antrozous pallidus)*
Status: Federal None/ California Species of Special Concern
Life History: This species occurs in a wide variety of open, dry habitats. Rocky outcrops, cliffs, and crevices are important for roosting. This bat requires access to water, but has good urine-concentrating abilities (Zeiner et al. 1990b).

Records and Likelihood of Occurrence: A male pallid bat was captured in a mist net set over the mine pit pond during Brown's 1990 surveys and guano of this species was found in two adits west of the Project site (Brown 1991). The species is therefore considered highly likely to forage in areas near the access roads and rail line, and is known to forage over the pond in the bottom of the East Pit of the existing mine.

California Mastiff Bat *(Eumops perotis californicus)*
Status: Federal Category 2 Candidate/ California Species of Special Concern
Life History: Mastiff bats inhabit a variety of arid to semi-arid, open habitats, including desert scrub. They feed on insects, and roost in deep rock crevices with vertical faces, high buildings, trees, and tunnels (Zeiner et al. 1990b).

Records and Likelihood of Occurrence: Brown's 1990 survey of the mine site did not detect this species, but suitable habitat is present, and the species is listed as one that might occur at various times in the Project area (Brown 1990). Dr. Brown states that the species has been detected at Cottonwood Spring in Joshua Tree National Park, and may occur seasonally in the Project area (pers. comm., August 21, 1995). All Project areas are within the range of California mastiff bats.

American Badger *(Taxidea taxus)*

Status: Federal None/ California Species of Special Concern

Life History: This animal is found in a variety of dry, open habitats throughout the state. It requires friable soils for burrowing, and feeds on burrowing rodents, especially ground squirrels and pocket gophers. Badgers breed during the summer and early fall months. The gestation period ranges from 183 to 265 days. Litters average two to three young, though up to five young may be born at one time. These are born typically in March and April. Females may sometimes breed in their first year, but males do not reach sexual maturity until they are two years old (Zeiner et al. 1990b). When present, they are detected by numerous digs, particularly at the bases of shrubs; dens are less often observed, and scat even less frequently.

Records and Likelihood of Occurrence: Badgers were detected during CMBC's 1995 surveys at the proposed landfill site and near Kaiser Road. There is a high likelihood that the species occurs along the rail line as well, since suitable habitat is present.

Nelson's Bighorn Sheep *(Ovis canadensis nelsoni)*

Status: Federal None/ State Special Animal

Life History: Bighorn sheep feed on green, succulent grasses and forbs as well as browse (shrubs). These animals prefer areas of low shrubs or other low vegetation for feeding, with access to steep, rocky slopes for escape, cover, lambing, and bedding. Water is required. Lambing takes place on steep, rugged slopes and canyons, between mid-April and June. Travel routes between feeding, bedding, lambing, and watering areas are also critical (Zeiner et al. 1990b).

Records and Likelihood of Occurrence: The Data Base (California Department of Fish and Game 1994d) reports Nelson's bighorn sheep from the Eagle, Coxcomb, and Chuckwalla Mountains, the northwest parts of the Chocolate Mountains, and Mecca Hills, south of Box Canyon. RECON (1991) estimates local populations at 50 in the Eagle Mountains, 50 in the Orocopia Mountains, 35-40 in the Chuckwalla Mountains, and 100 in the Chocolate Mountains. They further state that the subpopulation of the Eagle Mountain herd in the Coxcomb Mountains was thought to be declining, and that corridors between the Eagle and Coxcomb Mountains and Orocopia and Chocolate Mountains may be affected by the planned Project, citing personal communications with Dick Weaver in 1990 (RECON 1991).

Steve Torres, the statewide bighorn sheep coordinator for the Department, estimates that there are between 100 and 150 sheep in Orocopias, 25 to 50 in the West Chuckwalla Mountains, and an unknown number of sheep in the Chocolate Mountains (Torres pers comm., August 15, 1995). A Department study of the Orocopia Mountains population is ongoing; 26 sheep are being monitored by radio transmitters. Nancy Andrews, wildlife biologist for the Lower Colorado unit of the Department, indicated that rams were recently documented moving from the Orocopias across the rail line to the West Chocolates (pers. comm., August 15, 1995). Andrews reports that about 25% of the collared rams have moved between these ranges, and that such movement is very important to the local metapopulation. There is no documented movement across Interstate 10. The Department has been and will continue to monitor sheep populations in the Orocopia Mountains into the foreseeable future. The Orocopia population is very healthy and self-sustaining (Torres pers. comm., August 15, 1995). Torres indicated that the Orocopia population was the best in Riverside County south of I-10, and maybe north as well.

Andrews' radio-telemetry study of the Orocopia Mountains herd began in June 1994. Twelve (12) males and 14 females have been equipped with radio collars. The study has shown a significant amount of movement between the Orocopia and Chocolate Mountains. At least three radio-collared rams have travelled between Orocopia and Chocolate Mountains several times. Track surveys in the Salt Creek wash show that significantly more than three animals have crossed between ranges; ewes and lambs are also moving back and forth. At least one more year of data will be needed to determine the factors involved in this movement. Travel between the mountain ranges could relate to the rut, weather, and forage quality, etc. The Chocolates have steeper and more rugged terrain than the Orocopias, which could be attractive as lambing habitat. The "corridor," where the majority of tracks are seen is 4.8 to 6.5 km (three to four miles) long, from 1.6 km (one mile) southeast of the rail trestle, to about 4.8 km (three miles) northwest (Figure l.).

Only two water sources are available to bighorn sheep in the southern Orocopias; both of these sites are within 3.2 km (two miles) of the rail line. A main wintering area is also within about 0.8 km (one-half mile) of the rail line.

An ongoing monitoring program is being carried out on the Eagle Mountain bighorn sheep population. As of September, 1994, 28 animals had been fitted with radio collars, and their movements monitored via 32 radio telemetry monitoring flights (Divine and Douglas 1994). Data from this work has been analyzed using a geographic information system (GIS). In addition to air surveys recording the positions of radio-telemetered animals, ground surveys and water source surveys have been carried out, a weather station has been installed to allow better assessment of the effects of precipitation and temperature fluctuations on the population, and disease testing and genetic analyses of blood samples from the sheep captured during the radio telemetry study have been carried out. Preliminary results from this monitoring work can be summarized as follows (Divine and Douglas 1994):

- Two distinct ewe groups are present in the Eagle Mountains; these groups do not appear to intermingle.

- One of these groups uses the northern section of the mountain range, in areas surrounding the mine, while the other is concentrated in the southern section of the range. (Specific locations of sheep concentrations are given in the report, and will be used for designing mitigation. Place names are not given here, to avoid increased harassment or poaching of sheep).

Animals and sign were detected by both RECON and CMBC during surveys of the proposed landfill site (Figure h.). RECON also detected them at several locations along the rail line. The likelihood of occurrence along access roads is considered low, due to the preliminary results from monitoring studies, as well as the distance from steep terrain needed for cover and escape from predators.

Field Surveys.

Previous studies. RECON's (1991) biological technical report lists 92 plant species, 7 reptiles, 20 mammals, and 41 bird species observed during surveys of the Project areas (Appendix B.). Of these, four plant species, one reptile, three mammals, and two bird species had special-status designations at the time of their surveys. Three plants and one bird species are introduced species; all other species observed are native to the area. Locations of observations of special-status species are shown in Figures g. and h., and described in previous sections of this chapter.

Current (1995) studies.

Landfill. Transects surveyed earlier during RECON's studies (RECON 1991) and recently by CMBC are shown in Figure e. Our surveys were concentrated in areas east and south of the proposed landfill, and in undeveloped areas not extensively surveyed by RECON. No surveys were performed in the developed portions of the existing mine, much of which is denuded of vegetation and not representative of the plant communities and resources that once occurred. Our findings were not significantly different from those of RECON; no new special-status species were found; additional individuals and sign were found for species already detected by RECON.

CMBC cautions the reader to not equate the number of plants reported with the actual number of plants present. In all cases, our surveys at best represent samples of the plants present, not absolute counts. In most cases CMBC observed more plants than were reported by RECON (1991), even though these counts still underestimate the actual number of individuals present. The numbers of individual plants counted for each survey area are given in Figure g., which should be compared with Figure e. for the locations of transects surveyed. In general, it appears that both barrel cactus and Alverson's foxtail cactus are distributed throughout the undeveloped portions of the proposed landfill. As would be expected, barrel cacti are mostly found on the steeper, rocky areas to the north while foxtail cacti are found in rocky, but more level areas, to the east and south; either species may be found singly anywhere within undisturbed areas.

As with plants, no significant new findings were recorded for animals. Two species, common chuckwalla and Loggerhead Shrike, were not assigned special statuses at the time of RECON's surveys, and were therefore not mapped in the 1991 technical report. Common chuckwallas are found throughout the steep, rocky areas to the north and west; no sign was found in the rocky alluvium south of the Townsite or east of the existing mine. Although Loggerhead Shrike was only observed in two places (Figure h.), they may occur anywhere on-site, in undeveloped or developed areas. Although not mapped, Black-tailed Gnatcatchers were observed many places throughout the proposed landfill footprint. Bighorn sheep scat and beds were found throughout the northern and western portions of the site, and were absent from areas south of the Townsite and east of the existing mine, which is consistent with RECON's findings.

RECON (1991) had found tortoise sign (i.e., two burrows) only within the railroad loop south of the Townsite. CMBC also found tortoise sign in this area, including one scat and an old carcass. Sign found in new places by CMBC included three scat south of the Townsite, an old, collapsed burrow just south of the junction of the aqueduct road and Kaiser Road, and scat, burrows, and tortoises within the northeast boundary of the proposed landfill site and just east of the northeast corner (Figure h.). Two tortoises, including a juvenile and adult, were found within about 305 m east of the site. Two burrows and a scat were observed just northeast of Phase 4 in the side of the drainage found in that area. No tortoise sign was found elsewhere within the proposed landfill footprint by either RECON or CMBC. Within the five phases, tortoises are most likely to occur along the northern and northeastern boundaries of Phase 4, only.

Eagle Mountain and Kaiser Roads. Within the Draft EIS/EIR, Eagle Mountain Road is the proposed access road although Kaiser Road is the biologically preferred alternative. Only Eagle Mountain Road had been surveyed by RECON (1991). As noted, CMBC surveyed both roads by transects 9, 183, 366, and 732 m east and west of each of the roads (see Methods section).

The results of these surveys and RECON's surveys are depicted in Figure i. Along Eagle Mountain Road, our results were remarkably similar to those of RECON: except for one burrow and one scat located about 1.6 km (one mile) north of Victory Pass, all tortoise sign was found along the southern 5.6 km (3.5 miles) of the road, on both sides and mostly within 366 m of the road. An adult tortoise was found about 305 m north of Interstate 10, 366 m west of the road, and a second adult tortoise was found 2.4 km (1.5 miles) north of Interstate 10, 732 m east of the road. Loggerhead Shrike, Black-tailed Gnatcatcher, and common chuckwalla were also found along Eagle Mountain Road, as mapped in Figure i. Additional gnatcatchers and several LeConte's Thrashers were observed but are not mapped. A total of 24 tortoise sign and two tortoises were found along Eagle Mountain Road and the 12.9 km (eight mile) survey route.

The largest number of Alverson's foxtail cactus observed within all Project areas were recorded on the eight transects surveyed along Eagle Mountain Road. Although not mapped, 81 individuals were found south of the Eagle Mountain Road-rail line junction, and 71 additional individuals were observed between that junction and the aqueduct road to the north. Only 11 of these plants were observed within 9 m either side of the road; i.e., within the proposed expansion area.

Tortoise sign found along the northern 6.5 km (four miles) of Kaiser Road, between the aqueduct road and the Riverside County Sanitary Disposal Site, are shown in Figure i. No tortoise sign was found along the southern 6.5 km of the road, between Desert Center and the disposal site. Except for a carcass found just south of the disposal site, all tortoise sign was found on the east side of Kaiser Road, and most of that on the transects 366 and 732 m east of the road. Other species found along Kaiser Road included two Loggerhead Shrikes, one Black-tailed Gnatcatcher, two American badger digs, one Sharp-shinned Hawk at Lake Tamarisk, and two crucifixion thorns about 1.6 km (one mile) north of Lake Tamarisk, 732 m east of Kaiser Road. Additional gnatcatchers and several LeConte's Thrashers were observed but are not mapped. Also not mapped are 12 barrel cacti and 13 Alverson's foxtail cacti, which were found in the area 1.6 km (one mile) south of the aqueduct road, mostly on the east side of Kaiser Road.

Analysis of Mitigation Measures to Protect the Desert Tortoise.

During the lawsuit challenging the sufficiency of the EIR, Judge McConnell of the San Diego Superior Court made the following ruling on July 26, 1994:

> *There is not substantial evidence to support the conclusion that the mitigation measures will be effective in reducing the risks to the desert tortoise...[t]he EIR discusses the threats and describes proposed mitigation measures including monitoring, relocation, construction of culverts under the road and rails, berm over the tracks, and barriers, among other measures. The EIR concluded "...given the proposed tortoise mitigation, tortoise impacts appear mitigable to nonsignificance." (6 A.R. 2652.) There is nothing in the record to support this conclusion.*

The Service consulted with the Bureau under Section 7 of the federal Endangered Species Act and determined, in its Biological Opinion (1-6-92-F-39) (USDI Fish and Wildlife Service 1992a), that the Project would not jeopardize the continued existence of desert tortoise if specified terms and conditions (i.e., mitigation measures) were implemented. This "no jeopardy" opinion was reaffirmed in 1993, following a conference with the Service to determine if critical habitat for the desert tortoise would be adversely affected (USDI Fish and Wildlife Service 1993b). In addition, the Department issued a California Endangered Species Act Memorandum of Understanding (2081 permit) for the Project (California Department of Fish and Game 1994b), with a set of terms and conditions nearly identical to those given in the federal Biological Opinion.

As described in Chapter 2, CMBC has chosen to address the Judge's concerns by conducting a thorough analysis of Biological Opinions issued for the desert tortoise. CMBC reviewed 234 Biological Opinions that authorized 263 projects where tortoises could have been affected in California and Nevada. CMBC reviewed 126 of the 133 (95%) Biological Opinions issued for tortoises in California, excluding those opinions that regulated off-highway vehicle events and grazing. One-hundred-and-eight (108) of the 182 opinions (59%) issued in Nevada were reviewed. The remaining files were not available at the central field office in Reno, Nevada. Since a vast majority of the habitat of the desert tortoise is located on federal lands, this analysis covers the bulk of projects for which tortoise mitigation has been required by the Service.

In each opinion, anticipated harassment limits (i.e., the number of tortoises that may be handled) and anticipated mortality limits (i.e., the number of tortoises that may be accidentally killed) are specified. If either of these limits is met, the project proponent is instructed to cease construction or operation of the project and reinitiate consultation between the federal Lead Agency and the Service to determine why the limits were met, and determine additional measures to avoid exceeding revised limits. Failure by the proponent to report meeting these limits, and failure to reinitiate formal consultation with the Service when limits are met, are violations of the Act, and proponents and contractors are subject to civil and criminal penalties for such violations.

Also in each opinion, terms and conditions and other measures required by the Service are given to avoid excessive harassment and mortality of tortoises. A consultant's report may indicate that 10 tortoises occur on a given site. For such a site, the Service may say that 10 tortoises can be handled and one accidentally killed. The Service reasons that the terms and conditions will avoid mortality for all but one of the 10 tortoises; if one tortoise is accidentally killed, the terms and conditions are said to effectively protect tortoises. Therefore, the authorized mortality limit is the acceptable number of tortoises that may be accidentally killed, in spite of the terms and conditions, without jeopardizing the species (pers. comm. Ray Bransfield and Kirk Waln, Service wildlife biologists, 11 Oct 1995).

Five regulatory documents have identified mitigation measures to protect desert tortoises for the Eagle Mountain Project. These are the federal Biological Opinion (U.S. Fish and Wildlife Service 1992a), the Department's 2081 permit (California Department of Fish and Game 1994b) and 1603 Streambed Alteration Agreement (California Department of Fish and Game 1994c), the Bureau's Record of Decision (USDI Bureau of Land Management 1993), and the final EIS/EIR (USDI Bureau of Land Management and Riverside County 1992).

With the exception of establishing a 35 mile per hour speed limit on Eagle Mountain Road (USDI Bureau of Land Management 1993), the Biological Opinion issued for Eagle Mountain includes all mitigation measures to protect tortoises that are given in the other four regulatory documents. Therefore, analysis of the efficacy of the measures to protect tortoises given in the Biological Opinion includes all measures identified to date for the Eagle Mountain Project.

<u>Authorized versus actual harassment limits.</u> Data are tabulated in Appendix D., and summarized as follows:

In California, 126 Biological Opinions have authorized 123 projects, 101 of which have occurred.

- Eighty-eight (88) of those 101 opinions authorized the handling (harassment) of 1,362 tortoises.
- The remaining 13 opinions allowed for unlimited harassment.
- Thus far, 919 tortoises have been reportedly moved from harm's way as authorized by those 101 opinions.

In Nevada, 108 opinions have authorized 140 different projects, 70 of which have occurred.

- Sixty-six (66) of those 70 opinions authorized the handling (harassment) of 1,742 tortoises.
- The remaining four opinions allowed for unlimited harassment.
- Thus far, 536 tortoises have been reportedly moved from harm's way as authorized by those 70 opinions.

Therefore, during construction, operation, and maintenance of about 171 different projects in California and Nevada:

- a total of 1,455 individual tortoises have been moved from harm's way. Individual tortoises were often handled multiple times. Many other tortoises were kept from harm's way by other mitigation measures, such as tortoise-proof fencing.

Harassment limits have been:

- met in California (101 opinions) one time and exceeded six times.
- met in Nevada (70 opinions) two times and exceeded six times.

Most of the tortoises have been handled during long, linear projects, such as pipelines and transmission lines, and a majority of these tortoises were handled during only three projects. Such projects differ from the landfill and rail operation in that new areas were impacted on a continuous basis as construction proceeded, and fencing of construction areas was impractical or at least not required.

- Of the 565 tortoises handled during pipeline projects, 559 of them (98.9%) were handled during construction of the Mojave-Kern Pipeline, which spanned the entire north-south and east-west axes of the tortoise's range, through California, Nevada, and Arizona.

- Of the 227 tortoises handled during installation and maintenance of transmission lines, 174 (77%) have been handled during installation of the Meade, Nevada to Adelanto, California transmission line.

- Of the 53 remaining tortoises (i.e., 227 minus 174 handled on the Meade-Adelanto project), 41 (77%) were handled along the access road and project site at the LUZ Solar Generating Plant near Harper Lake, San Bernardino County, California.

Cumulatively, 774 of the 919 tortoises handled (84%) were handled during these three projects.

<u>Authorized versus actual mortality limits.</u> Unlike some harassment limits that allow an unlimited number of tortoises to be handled, there are no unlimited mortality limits; every opinion has a stated number of tortoises that may be accidentally killed. If the mortality limit is reached, all project activities that may result in another death must stop, the federal Lead Agency contacted, and consultation reinitiated with the Service.

Authorized and actual mortality data are tabulated in Appendix D., and summarized as follows.

In California, the 101 opinions implemented:

- Authorized the incidental mortality of 394 tortoises.

- Of 394 mortalities authorized, 53 tortoises (13%) have been accidentally killed.

- The mortality limit has been met one time (American Girl Mine in Imperial County, where only one tortoise death was authorized).

- The mortality limit has been exceeded one time (Kern portion of the Mojave-Kern Pipeline where 29 tortoises were accidentally killed, exceeding the 25 tortoise mortality limit by four tortoises).

- Thirty-eight (38) of the 53 tortoises reported dead (72%) were accidentally killed on the Mojave-Kern Pipeline.

- Four linear projects have been responsible for 91% (i.e., 48 of 53) of reported tortoise mortality:
  - Mojave-Kern Pipeline (38 tortoises)
  - LUZ Solar Electric Generating Plant (four tortoises, three found along the access road, which is not fenced)
  - Meade-Adelanto Transmission Line (three tortoises)
  - Fort Irwin's Current Mission (four tortoises found along tank trails)

- Tortoise mortality has been reported on only 8 of the 101 projects that have occurred. These included:
  - two mining projects
  - one highway project
  - two electrical transmission projects
  - one pipeline
  - two miscellaneous military projects

In Nevada, the 70 opinions implemented:

- Authorized the incidental mortality of 702 tortoises. The relatively large mortality limit is due mostly to one project, the Kerr-McGee Apex Project, where 416 tortoise deaths were authorized.

- Of 702 mortalities authorized, six tortoises (0.8%) have been accidentally killed.

- The mortality limit has been exceeded one time (Mission Hills Flood Control Structure in Henderson, Nevada where one construction-related and two maintenance-related mortalities were authorized and two tortoises, an adult and a juvenile, were actually killed during construction).

- The mortality limit has not been met for any of the other 69 opinions.

- Unlike California, most of the mortality cannot be attributed to one or several projects. The six tortoises were accidentally killed on five different projects:
  - three tortoises during transmission line and fiber optic cable installation
  - one tortoise during expansion of a landfill
  - two tortoises during construction of the Mission Hills facility..

Cumulatively, in both California and Nevada, during the 171 opinions that have thus far been implemented:

- the Service authorized the incidental mortality of 1,096 tortoises.

- Fifty-nine (59) of the authorized 1,096 tortoise mortalities (5.4%) reportedly occurred.

The Service has indicated that the authorized mortality limit is the acceptable number of tortoises that may be accidentally killed, in spite of the terms and conditions, without jeopardizing the species; tortoises would be effectively protected if the authorized mortality limit was met for each project. We see with the above analysis that only 5.4% of the authorized mortality limit was reportedly met; an additional 1,037 reported mortalities could be allowed and tortoises still effectively protected.

The above analysis also indicates that 1,455 tortoises were moved from harm's way during the 171 projects that occurred. Although not all of the tortoises would have died if not moved, it is reasonable to assume that some of these tortoises would have been killed if not rescued. In the absence of the terms and conditions, these 1,455 tortoises would have been exposed to construction and maintenance activities without the benefit of protection.

Given this information, CMBC concludes that implementation of the terms and conditions for projects that have thus far occurred has effectively protected tortoises; the number of tortoises actually killed relative to the numbers that were authorized is substantially lower than would be expected in the absence of protective measures.

To further address the Judge's concerns, it is important to determine the similarity of the terms and conditions thus far successfully implemented to reduce tortoise mortality with the terms and conditions that would be implemented for the Eagle Mountain Project.

<u>Similarity of previously implemented terms and conditions with those of Eagle Mountain's Biological Opinion.</u> Terms and conditions given in Eagle Mountain's opinion are separated into 21 different categories. Nine of these are termed "core conditions," as they are typical requirements found in other Biological Opinions (Table 3-6). Eight of the remaining 12 categories have occasionally been required in other Biological Opinions, and four are unique to Eagle Mountain (Table 3-7).

Core conditions. Each of these conditions would be required for the Eagle Mountain Project. They are lettered "a" through "i": (a) buy land to compensate impacts, (b) revoke permit if conditions are not implemented, (c) appoint a field contact representative, (d) conduct tortoise awareness programs, (e) check beneath vehicles to avoid crushing tortoises, (f) designate the work area and restrict project activities to that zone, (g) have a biological monitor on-site throughout construction phases of the project, (h) use tortoise-proof fences to restrict tortoises from the work area, and (i) report efficacy of the measures to the regulatory agencies at the end of construction or periodically during project operation.

Having categorized the measures, CMBC then evaluated each of the 234 opinions issued in California and Nevada, and summarized the commonness of the core conditions in those opinions (Appendix D.). Since CMBC was interested in the efficacy of the terms and conditions that have been implemented, only those 171 opinions that have been implemented are included in Table 3-6.

Table 3-6.
Percent Core Conditions Found in 101 California and 70 Nevada Opinions That Have Been Implemented.

Condition	Description	California	Nevada
a.	Buy land	44%	0%
b.	Revoke permit	22%	1%
c.	Appoint field contact	77%	87%
d.	Tortoise awareness program	99%	99%
e.	Check beneath vehicles	64%	25%
f.	Define work zone	91%	93%
g.	On-site monitor	98%	99%
h.	Tortoise-proof fences	59%	75%
i.	Project end report	72%	8%

The three most common terms and conditions cited in all Biological Opinions, which are also included in Eagle Mountain's opinion, are *tortoise awareness program*, *define work zone*, and *on-site monitor*. Five of these nine terms and conditions (d, e, f, g, and h) are field-related measures that are intended to avoid tortoise mortality during construction, operation, and maintenance. Based on CMBC's experience monitoring construction in occupied tortoise habitat (Appendix F.) and discussions with Ray Bransfield and Kirk Waln of the Service's Ventura office, we believe that the four measures that provide the most protection to tortoises include *tortoise awareness program*, *define work zone*, *on-site monitor*, and *tortoise-proof fences*.

Tortoise education programs given to construction personnel in the field result in an increased awareness of tortoises on the job site. In CMBC's experience, many tortoises are reported to our monitors by construction personnel who far outnumber the one or two monitors typically assigned to a project. In one case, a professional geologist working for three years near Ludlow, California reported that he had never seen a tortoise on the project site. He and others were given a tortoise awareness program on a Monday morning and he saw his first tortoise on the project site on Friday of that same week (LaRue, pers. obs. 1992).

Defining work zones and restricting construction activities to those zones minimize impacts to tortoises and their habitat. Physical demarcation of the construction zone reminds workers that they are in tortoise habitat and allows the biological monitor to enforce restriction of construction activities to that zone. The impact area is closely surveyed, tortoise burrows excavated, and tortoises removed from harm's way. Restricting construction to that cleared area protects tortoises and burrows found outside the impact zone. **On-site monitors** move tortoises out of harm's way, enforce compliance with the Service's terms and conditions, heighten the awareness of workers, etc. **Tortoise fences** exclude tortoises from harm's way. Most reported mortalities have occurred on pipelines and transmission lines, which cannot be effectively fenced. Boarman's studies (1995) have clearly indicated that tortoise mortality is significantly lower along Highway 58 because of tortoise-proof fences.

In the previous section, CMBC reported that only 59 tortoises have been reportedly killed during 171 projects where the above terms and conditions were required. We concluded that these numbers indicate that tortoises have been effectively protected during Service-authorized projects. In this section, CMBC reports that core conditions d, f, and g were required for most of the 171 projects where tortoises were protected. Based on professional experience and discussion with the Service, we conclude that these three measures and tortoise-proof fencing are the most effective measures in protecting tortoises during construction, operation, and maintenance activities of projects in tortoise habitat. CMBC cites this information as evidence that tortoises have been protected by the same terms and conditions that would be required for the Eagle Mountain Project.

Other Conditions. These measures are also found in the Eagle Mountain opinion, but are not typically found in other Biological Opinions. These other measures are lettered "j" through "u": (j) install ballasts along the rail line, (k) install culverts under rail line, (l) install culverts under roadway, (m) cover refuse at landfill, (n) monitor raven populations, (o) remove road-kills to reduce potential raven forage, (p) monitor rail line to remove tortoises from tracks, (q) monitor tortoise populations, (r) fence landfill to exclude predators, (s) control ravens with chemical deterrent, (t) eliminate ravens observed nesting on facilities, and (u) collect fees to be used in a conservation trust fund.

Table 3-7 lists the number of opinions in which the same or similar measures are required. The table includes all projects with the required measure, including those that have not yet occurred.

Table 3-7. Number of Opinions for which "Other Conditions" are Required.

Condition	Description	California	Nevada
j.	Install ballasts	0	0
k.	Rail line culverts	2	2
l.	Roadway culverts	6	5
m.	Cover refuse	1	3
n.	Monitor ravens	11	0
o.	Remove road-kills	0	0
p.	Monitor train trips	0	0
q.	Monitor tortoise populations	7	1
r.	Fence landfill	2	2
s.	Chemical deterrent of ravens	0	0
t.	Eliminate raven nests	18	0
u.	Conservation trust fund	0	2

Measures k and l require the installation of culverts along the access road and rail line. Culverts are intended, often in combination with fencing, to reduce impacts from roads and railroads to the desert tortoise. Negative impacts to tortoises from roads and highways have been well documented (Nicholson 1978, LaRue 1992, Boarman 1995, Hoff et al. in prep., etc.). However, the question of whether culverts can be effective in preventing fragmentation of tortoise populations divided by barriers such as highways and railroads remains unclear.

Reported culvert use by tortoises along fenced highways has been equivocal (Boarman 1995): "The most conservative interpretation of the data available suggests that tortoises may occasionally use culverts to cross a highway or similar barrier. ...There are currently no data to support the contention that tortoises will regularly use culverts." However, since Boarman's report, two tortoises have crossed under Highway 58 on four occasions between July and September, 1995 (Boarman, pers. comm., 15 September 1995). Studies of culvert use by tortoises in experimental settings (Fusari 1982, Ruby et. al. 1994) show that tortoises appear to learn to use culverts over time, especially tortoises resident in areas adjacent to culverts. More data are needed to determine the extent of tortoise use of culverts (Fusari 1982, Boarman, pers. comm., 15 September 1995).

Tortoise-proof fencing would be erected around the landfill and along the access road and, if needed, along the rail line (Chapter 5). Boarman recommends that culverts be used in combination with fences to prevent road-kills and avoid population fragmentation (Boarman 1995). The effectiveness of tortoise-proof fences in preventing road-kill mortality has been fairly well studied. Boarman (1995) found significantly fewer tortoise carcasses along a fenced area than along an unfenced area, indicating a 93% reduction in mortality due to protection afforded by the fence. Additionally, 88% fewer vertebrate carcasses (other than tortoise) were found along fenced versus unfenced study areas.

Other important recommendations for use of fences and culverts include using automatic gates or "tortoise-guards," similar to cattle guards at gates (Boarman 1995), and avoiding chicken wire or similar materials in fencing, to prevent stress, potential injury, and energy impacts to tortoises (Fusari 1982), and, in so doing, avoid injury and mortality of other animals, including snakes, lizards, and hares (Engelke 1992).

Installation of ballasts to reduce fragmentation of tortoise habitat (measure j in Table 3-7), removal of road-kills to avoid feeding tortoise predators (measure o), removing tortoises from the rail line ahead of each train trip (measure p), and chemical deterrence of ravens (measure s) are all intuitive measures that have been recommended for Eagle Mountain, but have not been recommended for other projects authorized by the Service. Since they have not been implemented, there is no record available to determine how effective they may be in protecting tortoises and avoiding habitat fragmentation.

California offices of the Service require more mitigation measures addressing potential impacts associated with Common Ravens than do the two offices in Nevada (i.e., consider measures n and t). However, none of these measures has been implemented for a period longer than five years, since 1990 when the tortoise was federally listed. Although these measures are intuitively appropriate, and may serve to eliminate the sponsorship of ravens by new development, there is little opportunity to determine their efficacy in avoiding increases of ravens in the desert. Non-project-related conditions that benefit ravens, such as increased road-kills and nesting opportunities, result in inflated raven populations even when development projects are designed to avoid that increase.

For Eagle Mountain, monitoring raven populations would be required to test the efficacy of the measures. Elimination of ravens, chemical deterrence, and other measures are required as contingencies to ensure that raven populations do not increase. And, into the foreseeable future, the regulatory agencies and others will be enlisted to continue to address the potential impact and develop and implement new measures as they are identified and required to avoid raven sponsorship.

Measure u, the conservation Trust Fund, is a key measure. Only two other projects reviewed have similar requirements, but neither of them approaches the scale of this project. Assuming full capacity of 20,000 tons of refuse each day, this fund could generate up to $6,000,000 per year for the purchase and conservation of desert tortoise habitat in Riverside County. It is likely the most substantial mitigation ever proposed for a single project in the desert.

Consider, for example, the Coachella Valley Fringe-toed Lizard Habitat Conservation Plan (HCP) (1985), approved by the Service in 1986. Since 1986, Coachella Valley developers have paid mitigation fees of $600/acre within the HCP boundary to support fringe-toed lizard habitat acquisition. Almost $23,500,000 have been spent to acquire 5,296 acres within the Coachella Valley Preserve (USDI Bureau of Land Management 1995), which is about $4,300/acre. During a nine year period with the landfill operating at full capacity, the Trust Fund would generate about $54,000,000 for land acquisition, which is twice as much as generated in the Coachella Valley. Private lands in southern Riverside County, where the Trust Fund would be used, sell for $350 to $500/acre. As such, during a nine year period with the landfill operating at full capacity, about 108,000 acres could be purchased and preserved; i.e., based on spending $54,000,000 for lands at $500/acre. This is 20 times more conservation land than has been acquired by the Coachella Valley HCP, which is one of the largest conservation plans currently in operation.

Summary and conclusion. Given the preceding analysis and discussion, CMBC concludes that implementation of the terms and conditions for projects that have thus far occurred has significantly reduced the number of tortoises actually killed relative to the numbers that were authorized. Had all mortality limits been met, the desert tortoise would not have been jeopardized in the Service's opinion. Only 5.4% (59 of 1,096) authorized tortoise mortalities have reportedly occurred for the 171 projects reviewed. Tortoise mortalities have been reported on only 13 of 171 (7.6%) projects where terms and conditions similar to those of Eagle Mountain have been required. Most known tortoise mortalities have occurred during construction of long, linear projects, such as pipelines and transmission lines.

CMBC concluded that *tortoise awareness programs*, *defining work zones*, *on-site monitors*, and *tortoise-proof fences* have afforded the most protection to tortoises during construction, operation, and maintenance activities on previously approved projects. These measures have been required for 99%, 92%, 98%, and 67%, respectively, of the projects occurring in California and Nevada where only 5.4% of authorized tortoise mortality has reportedly occurred. Given the similarity of the Biological Opinion issued for Eagle Mountain with the previous opinions issued, CMBC concludes that the mitigation measures required for the Eagle Mountain Project would effectively protect tortoises. Monitoring studies would be implemented and advisory committees established to ensure that protection was afforded and measures modified as necessary to deal with unforeseen impacts to tortoises and other biological resources.

Other terms and conditions included in the opinion for Eagle Mountain are unique or rarely required for other projects. Some of these (e.g., culverts) require more research and monitoring to determine their efficacy; others (e.g., fencing roads) appear to effectively reduce mortality of tortoises and other vertebrates. The establishment of the conservation Trust Fund is considered one of the most critical of these other conditions. The amount of this Fund, which could exceed $6,000,000/year, is unparalleled by any other project, and should facilitate conservation of key tortoise habitat in other locations in Riverside County.

Chapter 4
ENVIRONMENTAL CONSEQUENCES

In this chapter, the potential direct impacts are discussed relative to the species that are expected to occur in any or all of the Project areas. Significance criteria for impacts are based on the California Environmental Quality Act (CEQA), National Environmental Policy Act (NEPA), RECON's (1991) technical report, and professional judgement. Criteria and definitions are given in the following sections. For each species, CMBC presents the rationale for determining whether or not direct impacts are considered significant.

Significance Criteria.

Impacts are considered significant, as defined by CEQA and/or NEPA, if one or more of the following criteria is met:

Criterion 1. Substantially affect a rare or endangered species of animal or plant or the habitat of the species (CEQA *Statutes and Guidelines*, Appendix G. 1992) **and/or** may adversely affect an endangered or threatened species or its habitat that has been determined to be critical under the Endangered Species Act of 1973 (NEPA *Regulations*, 40 CFR § 1508.27).

Criterion 2. Interfere substantially with the movement of any resident or migratory fish or wildlife species (CEQA *Statutes and Guidelines*, Appendix G. 1992).

Criterion 3. Substantially diminish habitat for fish, wildlife, or plants (CEQA *Statutes and Guidelines*, Appendix G. 1992).

Criterion 4. Substantially degrade water quality or substantially degrade or deplete ground water resources (CEQA *Statutes and Guidelines*, Appendix G. 1992).

Definitions. Significant impacts are further characterized using the following definitions:

"Local Significant Impact." A significant impact to plants, animals, or other biological resources that are not unique to the area, but may be substantially and adversely affected by the proposed Project. Examples include desert bighorn sheep and chuckwalla, which are geographically widespread and also found in the Project area.

"Regional Significant Impact." A significant impact to plants, animals, or other biological resources that are unique to the area and may be substantially and adversely affected by the proposed Project. Examples of biological resources unique to the area include Eagle Mountain Scrub Jay, which is restricted to a limited geographical range in the vicinity of the Project, and desert pupfish, which, although widespread in disjunct areas, has a significant population in the vicinity of the Project.

"Potential Significant Impact." Significance of the impact will depend on the numbers of individuals affected, which will depend on the specific action, its location, and extent of habitat disturbance. Examples include unexpected, adverse impacts to pupfish and cumulative impacts to desert tortoises in adjacent areas. Monitoring these and other elements to ascertain their status and the extent of the impact will determine if the impact is significant or not. The potential for the impact will be substantially diminished with implementation of mitigation measures. The impact is less likely to occur than an impact listed as "Expected," as given in the next definition.

"Expected Significant Impact." As proposed, the Project would significantly impact a species if appropriate mitigation measures are not implemented. Examples include desert tortoise along the access road and Alverson's foxtail, both of which will be impacted and for which mitigation measures have been recommended to reduce the impact to a level below significance. The impact is more likely to occur than an impact listed as "Potential," as given in the previous definition.

Analysis of Impacts.

This section addresses the environmental consequences of the implementation of the Proposed Action and Alternatives for special-status species located in the immediate vicinity of the proposed landfill, rail line, and access road. The Draft EIS/EIR further assesses impacts relative to non-special-status resources occurring in the area. Species for which no or minimal impacts are expected are listed in Appendix C.

Plants and communities.

Alverson's Foxtail Cactus. RECON (1991) found two large concentrations of this cactus on the proposed landfill site. The southern part of the proposed storage area would impact 165 acres of habitat and at least 80 individual plants. An area of about 125 acres with at least 200 plants would be affected along the southwestern edge of the proposed footprint in the Eagle Creek Wash. About 33.3 acres of habitat would be impacted by access road improvements. Given 1995 survey findings, CMBC concludes that the population distribution was determined but not the density; the actual number of individuals is underestimated by both CMBC and RECON. All individuals within the proposed footprint would be lost if not salvaged.

Determination of Significance: Criterion 3, Expected Local Significant Impact. RECON (1991) found these impacts to be significant. CMBC concurs with this finding given the restricted distribution of the plant, the number of plants that would be affected, and the amount of habitat that would be lost.

California Barrel Cactus. All barrel cacti and occupied habitat within proposed landfill and access road areas would be lost. Some plants may also be lost during rail line maintenance. As with Alverson's foxtail cactus, all cited numbers likely underestimate the actual number of cacti occurring on-site.

Determination of Significance: Not Significant. Given the species' distribution throughout the Mojave Desert, CMBC does not consider the losses described above to constitute a significant impact. RECON (1991) states that due to the distribution and population levels of the species throughout its range, and the fact that many of these cacti occur in areas designated for open space within the proposed landfill site, the impacts to the species would not reach a level of significance requiring mitigation.

California Ditaxis, Desert Unicorn Plant, and Crucifixion Thorn. Aside from the two cactus species, of the special-status plants reported from the area, these three species and Orocopia sage (see below) are the only ones observed or expected within Project areas. Where these plants occur, impacts may include losses of individuals and suitable habitat. None of these species has been observed on the proposed landfill nor near the access road, where the greatest amount of ground disturbance and habitat loss would occur.

Determination of Significance: Not Significant. None of the plants has been found to date within the proposed footprint or access road, likely indicating that significant aggregations are absent from these areas. Measures are recommended to continue to search for and avoid impacts to these plants during rail line maintenance.

Orocopia Sage. Orocopia sage was found along the rail line during RECON's surveys. Impacts include potential loss of individuals from areas adjacent to the rail line.

Determination of Significance: Not Significant. Although a few individual plants were found along the rail line, most individuals occur elsewhere in the Orocopia Mountains and are not threatened by proposed development. Measures would be implemented to avoid the few plants that do occur along the rail line.

Fish, amphibians, and reptiles.

Desert Pupfish. RECON's technical report (1991) and Biological Assessment (1992a) list the following potential impacts to desert pupfish:

(1) Potential impacts to desert pupfish habitat from a rail accident or major construction on trestle over pupfish habitat.

(2) Potential impacts to water quality and possible direct kills of fish using habitat under the trestle during maintenance or construction activities.

The original EIS/EIR (USDI Bureau of Land Management and Riverside County 1992) also lists:

(3) Potential loss of individual desert pupfish and less than one acre of degraded habitat. The magnitude of these impacts would be greatest if a rail accident or major construction activities occurred during the fall months, when the pupfish population in Salt Creek and its tributaries falls to about 100 individuals, due to drops in water levels.

Weed abatement along the rail line will not involve use of herbicides or other chemicals, and will be carried out by hand. Trash carried over the rail line will be fully contained in closed containers and specially designed railcars. No impacts to pupfish are expected from either weed abatement activities or from windblown refuse.

During 1995 scoping sessions, individuals expressed concern regarding the use of groundwater at the landfill and the potential impacts to pupfish. In the Project area, pupfish only occur in Salt Creek approximately 64.5 km (40 miles) south of the proposed landfill. Salt Creek is the sink for a water table that is inclusive of portions of the Orocopia, Chocolate, and Chuckwalla Mountains. Groundwater would be taken from the Chuckwalla Valley, which is north of the Chuckwalla Mountains and primarily supported by runoff from the Eagle and Coxcomb Mountains. Therefore CMBC does not consider groundwater removal in support of landfill operations to affect pupfish.

Determination of Significance: Criteria 1, 3, and 4; Potential Regional Significant Impact. Given its status as a state- and federal-listed endangered species, any unauthorized "take" of pupfish would be in violation of State and Federal Endangered Species Acts, and unmitigated impacts would be considered significant under CEQA. Incidental "take" has already been authorized (USDI Fish and Wildlife Service 1992a), and mitigation measures have been designed to avoid significant impacts. Derailment and subsequent contamination of pupfish habitat in Salt Creek is not expected during normal operation of the rail line. Preventative measures, contingency plans, emergency measures, and monitoring repair and maintenance activities are all recommended to avoid derailment, rectify contamination, and minimize or avoid impacts to the pupfish population, respectively.

Desert Tortoise. Earlier environmental documentation (RECON 1991, RECON 1992a, USDI Bureau of Land Management and Riverside County 1992, USDI Fish and Wildlife Service 1992a) identified the following potential impacts to desert tortoises:

(1) An increase in the local raven population due to the availability of food at the landfill, and a potential increase of predation of young tortoises by ravens (see below for additional discussion). This effect could extend to tortoise populations within Joshua Tree National Park (RECON 1991).

(2) During track maintenance and repair, tortoise burrows located along the railroad berm could be collapsed and destroyed. Any tortoises occupying these burrows could be killed, and loss of unoccupied burrows could be a temporary loss of shelter for tortoises in the area.

(3) Tortoises could be killed or injured by trains once rail service to the landfill site begins. The berm and rail may constitute a partial barrier to tortoises, but tortoises and sign have been found on the tracks themselves (RECON 1991, RECON 1994a).

(4) Tortoises occupying habitat directly adjacent to the rail line may be subject to increased stress due to noise and vibration from passing trains. RECON's (1991) technical report gives a detailed account of research into the potential for permanent hearing loss in tortoises from train noise. The likelihood of such loss is considered low (RECON 1991).

(5) Activating the rail line may also constitute a barrier to movement of tortoises between the eastern and western portions of their current local range. Consequently, reproduction and exchange of genetic material between tortoise subpopulations on either side of the track could be severely reduced. Considering tortoise densities in the area and the quantity of available habitat, RECON (1991) concluded that isolation of desert tortoise subpopulations east and west of the rail line and the threat of long-term loss of population viability would constitute a significant impact if not mitigated.

(6) Improvements to access roads would result in a loss of up to 150 acres of desert tortoise habitat.

(7) A significant increase in road-kills would likely result from the projected 12- to 16-hour per day truck traffic along access roads. Concomitantly, raven and other scavenger populations would likely increase in the vicinity due to the availability of road-killed animals. Higher populations of predators may in turn result in increased desert tortoise mortality from predation. (Several authors have found significantly reduced densities of tortoises along roadways compared to adjacent areas of similar habitat: Nicholson 1978, LaRue 1992).

Other potential impacts stemming from the increased human presence in the area due to landfill activities include (8) vandalism and illegal collecting of tortoises, (9) possible increases in off-highway vehicle use, with subsequent degradation of tortoise habitat and direct mortality from crushing and collapsing burrows, etc., and (10) possible release of captive tortoises infected with Upper Respiratory Tract Disease into the wild population.

Changes in water flow patterns are expected to result in a pattern that more closely resembles the original hydrology of the area, before the Eagle Mountain mine became active. These changes could result in (11) occasional flash flooding of tortoise habitat immediately east of the mine site during storm events. RECON (1992a) states that since few or no tortoises occupy the area, and since flash flooding is a "natural occurrence in tortoise habitat," impacts from changes in water drainage patterns are not expected to be significant.

New scoping meetings with state and federal agencies, other concerned organizations, and individuals identified the following potential impacts:

(1) Potential for fire created by reactivating the rail line and the increased incidence along the access road. Given the availability of fuels sponsored by flashy, non-native annual vegetation, fires often burn hotter in the desert than they did historically. As such, tortoises and other wildlife are currently exposed to hotter fires that persist longer and cover larger areas than before the advent of the non-native fuels. Consequently, tortoises and other wildlife may be significantly impacted by Project-related wildfires if contingency plans are not in place to minimize or avoid this impact. Records maintained by Joshua Tree National Park since the 1930's indicate no Class A fires (i.e., fires affecting less than one-quarter acre) in the vicinity of the existing mine (pers. comm., Tom Patterson, 28 August 1995). Orlo Anderson of MRC indicated (pers. comm. 25 August 1995) that their records show no incidence of fire along the rail line during more than 40 years of operation.

(2) Potential loss of tortoises and tortoise-occupied habitat south and east of the proposed landfill footprint. RECON (1991) found a small amount of tortoise sign just south of the proposed landfill in the area where the rail line makes a large loop back towards the southwest; CMBC found more tortoise sign in this area. Additionally, CMBC found tortoises and their sign immediately east and north of existing mine tailings on the eastern portions of the existing mine, in areas just east of Phase 4. It is estimated that the landfill would reach Phase 4 areas in about 70 years. If tortoises are still present east of the footprint, development of the eastern and northeastern portions of Phase 4 may result in the loss of tortoises and possible occupied habitat.

(3) Although impacts associated with Common Ravens are discussed above, the following, new information is provided to further assess the impact of this potential predator. Ravens are a known predator of juvenile desert tortoises. Populations of tortoises in California show trends consistent with the hypothesis that "raven predation [has] significantly reduced the number of juveniles present in the population, hence reducing the number of animals eventually available for recruitment into the population of breeding adults...Reduced recruitment can be a major conservation concern for long-lived turtle species" (Berry 1985 and 1990, cited in Boarman 1993). Ravens are also notorious raiders of nests (Knight and Call undated), and may affect many species, including special-status bird species such as Eagle Mountain Scrub Jay (RECON 1991). Remains of common chuckwalla have been found at raven nests (Boarman and Berry in press). Actions that would increase local raven populations are considered a potential impact to desert tortoises and other prey species, although some authors consider that ravens that forage regularly at landfills and other highly concentrated food sources may seldom leave these sources to prey on native wildlife (Engel and Young 1992).

Populations of Common Ravens have increased in the deserts of California in recent years. Between 1968 and 1993, data from Breeding Bird Surveys show increases of raven sightings by 7,600% in the Central Valley, 1,400% in the Sonoran-Colorado Desert, and 1,000% in the Mojave Desert for this 24 year period (Boarman and Berry in press). These increases have been most noticeable in areas of human development, including landfills, highways, powerlines, etc. (FaunaWest Wildlife Consultants 1989, Knight and Kawashima 1993, Knight, Knight, and Camp 1993). Knowles and Berry (1989) found that "landfills constituted the major concentration areas" in their study of four regions in California deserts. Boarman (1993 and in press) considers ravens to be "subsidized predators," since populations and range have increased as food, water, perch, and nest sites have increased in California deserts due to human development.

Boarman and Camp (in prep.) have found that ravens at landfills "eat organic materials exposed along the active face of landfills and landfill operators report that ravens readily dig up food that is covered by 15.24 cm (six inches) of dirt cover." They also found that ravens make use of available water at landfill sites. FaunaWest (1989) observed ravens foraging at landfills in the following ways: (1) ravens exposed downslope and previously buried refuse at downslope operations by using their beaks to probe a few inches below the surface and were not observed to dig; (2) they broke open trash bags and removed the organic materials from the bags; (3) they fed on uncovered refuse at landfills where trash was buried on a daily or weekly basis; and (4) they fed on trash as it was being dumped at larger landfills.

Sewage ponds and dump sites, often located at landfill sites, were also used as a food source (human waste) and water source, and ravens were seen following behind trains along tracks near Nipton and Kelso (FaunaWest Wildlife Consultants 1989). The researchers thought these birds were feeding on spilled grain or foraging for train-kills. They observed that ravens preferred large, flat, cleared areas, often found within landfills, for daytime, communal roosting sites. CMBC has often observed ravens congregating in bare areas recently cleared by construction machinery; the ravens were feeding on lizards, small mammals, and other animals injured or killed during vegetation clearing (LaRue, pers. obs. 1993).

According to one study (FaunaWest Wildlife Consultants 1989), the area around Desert Center and near the existing Desert Center landfill already shows inflated numbers of ravens compared to surrounding desert areas. Conversely, Camp, Knight, and Freilich (1993) surveyed raven numbers in native desert scrub away from roads, in Pinto Basin, and Eagle Mountains of Joshua Tree National Park and Bureau "wilderness and natural lands," where they found a density of 4.63 ravens per 100 linear km. This is not high when compared to estimates of 36.5 and 73.5 ravens per 100 linear km in portions of the Mojave Desert more affected by human development (Knight and Kawashima 1993).

Determination of Significance: Criteria 1, Expected and Potential Local Significant Impact. Given its status as a state- and federally-listed threatened species, any unauthorized "take" of tortoises would be in violation of State and Federal Endangered Species Acts, and unmitigated impacts would be considered significant under CEQA. The "expected" impact is possible loss of tortoises and actual loss of habitat from 150 acres adjacent to the access road. All other impacts are considered "potential," as defined at the beginning of this chapter.

Common Chuckwalla. Individual chuckwallas and chuckwalla habitat would be lost in the development of the landfill and improvements on Eagle Mountain Road, and possibly along the rail line. Chuckwallas may be killed on the rail line or access roads, but the likelihood of such mortality is minimal, since chuckwallas seldom venture from rock outcrops into open habitats. Unless moved from harm's way, all chuckwallas residing within the landfill footprint would be lost. If local raven numbers increase in response to the Project, there will be a concomitant increase in the potential for chuckwallas to be preyed upon. During his 1977 through 1983 study in the Eagle, Orocopia, and Chuckwalla Mountains, Abst (1987) found 23 chuckwallas per hectare, or about 930 chuckwallas per 100 acres of suitable habitat. If this density is representative for the Project area, loss of 1,000 acres of rocky hillside from the landfill area, could result in the loss of about 930,000 chuckwallas during the 100 year operation of the landfill.

Determination of Significance: Criterion 3, Potential Local Significant Impact. Impacts to this species are considered potentially significant on a local level depending on the number of individuals that may be lost from the landfill site and the potential for increased raven numbers in response to the landfill. Scat were found throughout the undisturbed portions of the existing mine. If chuckwallas are very common, CMBC would consider the landfill to "substantially diminish habitat" (Criterion 3) in the local area. Given chuckwalla's distribution throughout the undeveloped, rocky areas of the Mojave Desert (Zeiner et al. 1988), the impact is not considered significant on a regional level.

Flat-tailed Horned Lizard. Impacts to flat-tailed horned lizard are not likely. Potential impacts are only possible near the southern terminus of the rail line, as the rest of the Project is outside the species' range. Potential impacts include increased stress due to train noise and vibration, train-kill of individuals, and increased predation if populations of predators, such as ravens and coyotes, increase due to train-killed carrion.

Determination of Significance: Not Significant. RECON (1991) found "horned lizard" scat 2.4 km (1.5 miles) south and immediately north of Interstate 10, which is 32.2 to 40.3 km (20 to 25 miles) north of the species' range (Zeiner et al. 1988). No horned lizard scat were found along the southern portions of the rail line, particularly near its southern terminus, which is near the species' range. CMBC concurs with RECON (1991), which states that "given the general lack of horned lizard habitat in the area [e.g., fine sands] these potential impacts would not be significant." The Bureau has concurred that flat-tailed horned lizard will not be adversely affected by the proposed Project (Oxendine, pers. comm., January 23, 1996).

Birds.

Birds of Prey, including Northern Harrier, Sharp-Shinned Hawk, Cooper's Hawk, Golden Eagle, Prairie Falcon, and Long-Eared Owl. Loss of nesting and/or foraging habitat may impact these birds of prey as a result of landfill operations and access road improvements. Disturbance from the operation of the landfill, increased truck traffic on access roads, and reactivation of rail service may impact birds nesting in the vicinity of these features, and could cause nest abandonment, lowered reproductive success, and increased stress to adult birds. No evidence of nesting raptors (particularly Golden Eagle and Prairie Falcon) was observed in the area by either RECON or CMBC.

Determination of Significance: Not Significant. Suitable nesting habitat for Golden Eagle and Prairie Falcon occurs throughout the Mojave, Colorado, and Sonoran Deserts, and the other species are not likely to nest in the Project area. Although potential foraging habitat would be lost to each of the species, foraging habitat is plentiful in the area, and adjacent lands protected by the National Park Service and Bureau will preserve most of the foraging habitat in the region. For these reasons, CMBC concludes that impacts do not satisfy the criteria established for significance.

Western Burrowing Owl. Burrowing owls have not been observed during any of the surveys performed by either RECON or CMBC. Where they occur (most likely in level, less rocky areas south and east of the proposed landfill, along Eagle Mountain Road, and adjacent to the rail line) burrowing owl burrows, used for both nest and roost sites, could be lost during construction and/or maintenance activities. Given the expected increase in vehicle traffic along Eagle Mountain and Kaiser Roads and the reactivation of the rail line, it is more likely that owls would be lost to vehicle and train collisions than to ground disturbance.

Determination of Significance: Not Significant. Approximately 944 acres of steep, rocky hillsides would be lost from the landfill (RECON 1991), and 150 acres of relatively level, although mostly rocky, land would be lost along the access road. As such, the Project would not substantially diminish owl habitat (Criterion 3). There is insufficient information available to determine the potential for vehicle and train collisions, although removal of road-killed animals, as recommended mitigation for tortoises, would provide an opportunity to assess this impact.

Eagle Mountain Scrub Jay. No direct impacts to Eagle Mountain Scrub Jays are expected, since this species inhabits pinyon-juniper and scrub oak woodland not present in any of the Project areas. RECON (1991, 1992a) and the EIS/EIR (USDI Bureau of Land Management and Riverside County 1992) identify potential increases in the raven population and consequent higher rates of raven predation on nestling scrub jays as a possible impact. The likelihood of this impact is somewhat remote since the scrub jay population occurs approximately 29.0 km (18 miles) west of the proposed landfill footprint.

Determination of Significance: Criterion 3, Potential Regional Significant Impact. The potential impact is considered to be "regional," as opposed to "local," because this race of scrub jay is restricted to the upper elevations of Eagle Mountain, 29.0 km west of the Project. CMBC concurs with RECON (1991) that the loss of any scrub jays due to the landfill would be considered a significant impact. As indicated, CMBC considers the likelihood of this impact to be minimal.

Black-tailed Gnatcatcher. Black-tailed Gnatcatchers were observed along the rail line, adjacent to access roads, and on the proposed landfill site. Appropriate and occupied habitat for the species would be lost in the development of the landfill and access road, and could be impacted by rail line maintenance.

Determination of Significance: Not Significant. The species is found throughout the eastern two-thirds of San Bernardino, Riverside, and Imperial Counties. Loss of habitat from along the access road and landfill is not considered to "substantially diminish habitat" (Criterion 3) for this species. RECON (1991) also found impacts to be not significant due to the availability of undeveloped habitat in the region.

Wash-associated resident birds, including LeConte's Thrasher, Loggerhead Shrike, and others. These species would likely experience some loss of habitat in wash areas, and potential degradation of habitat if wash areas are used for storage of equipment and materials, or as access routes during maintenance or construction activities. Long-term habitat loss or human activity in wash areas may cause resident birds to move to other areas of suitable habitat. Since suitable habitat is rarely unoccupied, these animals and those occupying the habitats to which the displaced animals move would experience higher levels of stress as they compete for territories and resources. Increased raven predation on eggs and young could also occur if raven populations increase.

Determination of Significance: Not Significant. LeConte's Thrasher and Loggerhead Shrike are likely common in the area. LeConte's Thrasher is found throughout the Mojave Desert, the Owens Valley, and San Joaquin Valley, and Loggerhead Shrike is found throughout California except to the northwest and the high Sierras (Zeiner et al. 1990). Consequently development and operation of the landfill will not substantially diminish habitat for these species (Criterion 3).

Migrant Birds, including Yellow Warbler, Yellow-Breasted Chat, and others. These two species and several others (see Appendix C.) are associated with riparian and wash habitats. Some wash habitat may be lost through the development of the landfill and improvements to the access road. Wash areas near the rail line may be impacted by maintenance activities, especially if storage of equipment and materials is allowed in wash areas, or washes are used to access the rail line and right-of-way.

Determination of Significance: Not Significant. Most of the wash habitat is found south and east of the existing mine and along the rail line, and as such will not be removed; habitat for these species will not be substantially diminished.

<u>Mammals.</u>

Bats, including California Leaf-Nosed Bat, Townsend's Big-Eared Bat, Pallid Bat, and California Mastiff Bat. Loss or disturbances at the Kaiser Eagle Mountain Mine and Black Eagle Mine adits, which are being used as roosts for California leaf-nosed bats, would likely cause these bats to abandon the site. The Kaiser Mine adit is particularly important for the species as it may be the only winter roost in the area (Brown pers. comm., August 21, 1995) and is a maternity roost. It has also been used by Townsend's big-eared bats, although there is no recent evidence of occupation. Loss of any surface water may impact pallid bats and other species, which are known to forage over open water.

Determination of Significance: Criterion 3, Expected Local Significant Impact. Dr. Pat Brown visited nine adits west of the mine site in Eagle Mountains, and found only two adits of any extent in the Coxcomb Mountains to the east. Aside from Kaiser Eagle Mountain Mine, no other confirmed leaf-nosed bat maternity roosts were found in the area; there was some potential for a summer maternity roost at "Lucky Turkey #2" on Joshua Tree National Park. Loss of this mine adit would significantly impact California leaf-nosed bats in the area. Given the bat's range over the eastern two-thirds of Imperial County, eastern half of Riverside County, and eastern quarter of San Bernardino County, this impact is considered more local than regional.

American Badger. Some habitat suitable for badgers will be lost in the development of the landfill and road improvements. Any burrows of badgers present along the rail line will be subject to greater noise and vibration, and some of these could collapse. The potential for road-kill or train-kill of badgers will be increased with the operation of the landfill. Badgers present in the Project areas may be subject to greater levels of stress due to increased noise, vibration, and human activity.

Determination of Significance: Not Significant. Given their geographic distribution through California except for the extreme northwest, impacts to badgers are not considered significant.

Nelson's Bighorn Sheep. RECON (1991, 1992a) and the EIS/EIR (USDI Bureau of Land Management and Riverside County 1992) identified several impacts to bighorn sheep from the implementation of the Project. These include the loss of four water sources used by Nelson's bighorn sheep: the pond at the bottom of the East Pit, two leaking water tanks on the south-central part of the proposed landfill site, and a temporary water source at the northeast corner of the mine. Water sources in the East Pit and northeast part of the mine are no longer present, so impacts would now result in the loss of only two water sources. Approximately 944 acres of bighorn habitat would be lost (RECON 1991). The landfill footprint is not believed to contain any high quality lambing areas (Douglas, pers. comm., January 31, 1996). Loss of habitat and increased noise and other human activity would create more stressful conditions for the sheep population in the mine area. Increased stress levels can affect the health of bighorn sheep, predisposing the animals to disease. The crowding of animals into a reduced area may also increase the likelihood of spread of disease between individual animals. Increased residential use in the Townsite may affect bighorn sheep, through increased disturbance from humans and their domestic animals, as well as increased potential for poaching. If residents are allowed to raise livestock, introduction of diseases to wild sheep from domestic animals is also possible.

No impacts are expected to bighorn sheep from increased use and improvements to access roads, since no evidence of sheep use near the access roads has been found, and habitats are not considered suitable for bighorn sheep in these areas.

Along the rail line, individual animals may be lost to train-kill. Night train traffic, with lights, could increase the number of individuals killed (Andrews pers. comm., August 21, 1995). Key wet season habitat and dry season water sources are located within 0.8 to 3.2 km (one-half to two miles) of the rail line. Maintenance activities, especially those involving vehicles and people on the ground could increase stress levels of sheep and potentially inhibit sheep from using crucial water sources (Andrews pers. comm., August 21, 1995). Habitats and bighorn sheep populations in the Orocopia and Chocolate Mountains may be fragmented where movement corridors are crossed by the reactivated rail line. This may result in reduced gene flow in bighorn sheep populations in these areas.

RECON's (1992a) Biological Assessment states that there is no evidence that sheep movement between mountain ranges was halted during previous operations. Steve Torres, the statewide coordinator for bighorn sheep for the Department, and Dr. Charles Douglas of the University of Nevada, Las Vegas, agree that the expected level of rail traffic would be unlikely to stop all sheep movement between the two mountain ranges (Torres pers. comm., August 15, 1995; Douglas pers. comm., August 10, 1995). However, a significant number of animals use this corridor (Andrews pers. comm., August 21, 1995). RECON concludes that no impacts are expected for bighorn sheep from reactivation of rail service. CMBC concludes that insufficient information is available to make this determination. Department bighorn experts (Torres pers. comm., August 15, 1995; MulCahey pers. comm., August 15, 1995) state that continued monitoring of these populations is needed. Further opportunities for studying this potential impact exist, and are discussed in Chapter 5.

Determination of Significance: Criterion 2 and 3, Expected and Potential Local Significant Impacts. Impacts to bighorn sheep currently found on the proposed landfill are "expected" and considered to be significant. Although the loss of about 944 acres may not substantially diminish habitat (Criterion 3) for sheep, which occur throughout Eagle Mountains west of the existing mine, the loss of four watering holes would significantly impact sheep currently using those water sources. Disruption of sheep use of water sources near Salt Creek could also be a significant impact. Potential disruption of sheep travelling between the Orocopia and Chocolate Mountains is considered a "potential" significant impact by interfering "substantially with the movement of any resident...wildlife" (Criterion 2).

Common wildlife and vegetation. Impacts to native wildlife and plant species with no special status may include loss of habitat and increased human disturbance, increased road-kill on access roads and train-kill on the rail line for many species, possibly including mule deer, antelope and round-tailed ground squirrel, kit fox, desert and Merriam's kangaroo rats, etc.

The deer herd for Zone D12 extends from Needles to Mexico along the Colorado River, west to the San Diego County line, and includes Joshua Tree National Park, north to State Highway 62. This zone has one of two action plans for all deer populations in the state. This population has particularly low densities of deer, making determination of population size extremely difficult. The population appears to be increasing, based on hunting statistics that show an increase in hunting success, coupled with a steady average age of deer killed. These animals make heavy use of the pass area between Orocopias and Chocolates, a bit further north than the sheep movement area. Nancy Andrews (pers. comm., August 21, 1995) states that cumulative impacts throughout D12 zone are a concern. These include habitat loss, increasing human disturbance, and effects to travel corridors from such large scale projects as the Mesquite Mine, Indian Rose Mine, and American Boy and American Girl Mines. Deer in the vicinity of the Chuckwalla, Orocopia, and Chocolate Mountains appear to be limited by the availability of water (Andrews pers. comm., August 21, 1995).

The movement corridor for both sheep and deer includes a 6.5 km (four-mile) stretch of Salt Creek, from 1.6 km (one mile) southeast of the trestle to 4.8 km (three miles) northwest (Andrews pers. comm, August 21, 1995). Specific impacts to deer from the Project include potential train-kill, which could be more pronounced with night train travel and lights, and increased human disturbance and stress from maintenance activities.

In addition, an increased human presence at the landfill and Townsite may lead to degradation of local habitats from increased off-highway vehicle use, increased predation of native animals by domestic dogs and cats, increased potential for introduction of non-native, invasive plants, such as tamarisk (*Tamarix* sp.) and giant cane *(Arundo donax)*. If coyote and raven populations increase, predation rates of many species, including eggs and young, may also increase. Additional discussion of these impacts is given in the Draft EIS/EIR.

Determination of Significance: Criteria 2 and 3, Potential Local Significant Impact. Disruption of deer movement along Salt Creek, an identified movement corridor, could be considered significant; however deer readily cross rail lines in other locations (Andrews pers comm., 21 August 1995). Habitat loss and alteration, increased raven and coyote predation, and road- and train-kill could have cumulative effects on local populations of many species. Unmitigated, these impacts may be considered significant.

All expected or potential impacts to the regional ecosystem are not addressed in this section, but are discussed in detail in the Draft EIS/EIR being completed by CH2M HILL. Some of these potential impacts include the effect of the removal of water from the Chuckwalla Valley water table, nitrogen deposition, effect on predator-prey relationships, sponsorship of nonnative plants and animals, overall ecosystem effects, and cumulative impacts to resources inside and outside Joshua Tree National Park. That they are not discussed herein is not intended to undermine the importance of these potential impacts. CMBC was informed by CH2M HILL staff that they would research and report on these impacts in the Draft EIR/EIS.

Chapter 5
PROPOSED MITIGATION MEASURES

Mitigation measures have been proposed in seven existing environmental documents issued for the proposed landfill. These include two State documents: California 2081 Management Agreement for the incidental take of desert tortoise and desert pupfish (California Department of Fish and Game 1994b) and California 1603 Streambed Alteration Agreement (California Department of Fish and Game 1994c) and five federal documents: Service's federal Biological Opinion authorizing the incidental take of desert tortoises and desert pupfish (USDI Fish and Wildlife Service 1992a), Bureau's Record of Decision (USDI Bureau of Land Management 1993), the Bureau's and Riverside County's Final, Joint EIS/EIR (USDI Bureau of Land Management and Riverside County 1992), a Memorandum of Understanding between the Proponents, Department, and National Park Service relative to bighorn sheep (National Park Service 1992), and a memorandum from the Army Corps of Engineers (Department of the Army 1994) indicating that the Project would be covered by nationwide permits. CMBC has not eliminated any of the mitigation measures recommended thus far for this Project.

For each species CMBC includes previous mitigation measures followed by additional measures deemed prudent and necessary to further minimize the potential impacts. CMBC recommends that all of the following mitigation measures be incorporated into the design of the Project and plans of operation. Expected or potential impacts are briefly stated prior to recommended measures. Following recommended measures is a determination of whether the impact would be reduced to below a level of significance.

Plants and Communities.

Alverson's Foxtail Cactus.
(1) *The Project would result in the loss of 165 acres of occupied habitat from the southern part of the proposed storage area, 125 acres from the southwestern edge of the landfill footprint, about 35 acres from access road expansion along Eagle Mountain Road, and small, undetermined impacts to individuals occurring along the rail line.* The EIS/EIR (USDI Bureau of Land Management and Riverside County 1992) and Record of Decision (USDI Bureau of Land Management 1993) outlined a plan to minimize impacts to this species. Pertinent components of the plan are given as follows: (a) Prior to ground disturbance the number of plants/acre will be determined and soils analyses will be conducted at current sites and potential transplant sites to assess compatibility; (b) 10 to 15% of the cacti will be used in the trial effort; (c) sites selected for the main transplant effort shall be planted with the remaining individuals salvaged from the impact areas of the proposed landfill at a density similar to that estimated for the natural population; (d) the final mitigation areas will be monitored once a month for one growing season to measure survivorship and determine success; and (e) a final report will summarize the effort and be submitted to the Bureau, Department, and Service.

RECON (1991) outlined a transplantation program for Alverson's foxtail cactus that has now been going on for two years. The results of this trial effort have been reported (RECON 1995) and are summarized as follows: Twenty (20) individual cactus were transplanted at two sites near the existing mine, but outside the future development areas. On April 27, 1995, RECON found that all 20 transplanted individuals were alive and appeared healthy. Only one of the transplanted cacti did not flower during the 1995 growing season. RECON (1995) recommended that the cactus mitigation program be started at least one year prior to impacting the cactus population, which would allow sufficient time to move the large number of cacti during the proper growing season.

Additionally, CMBC recommends the following measure be implemented. During rail maintenance and repair activities, staging and storage areas will be selected so that few, if any, Alverson's foxtail cactus are affected by those activities. The biological monitor on-site to observe such activities will perform preconstruction surveys and work with the construction supervisor to ensure that impacts to this cactus species are minimized and, preferably, avoided. The construction monitor is already required on-site to avoid impacts to tortoises; with this additional measure, CMBC recommends that the tortoise monitor also know how to identify foxtail cactus so that loss of individuals can be avoided.

CMBC concludes that implementation of these measures would reduce the impact to a level of not significant.

California Barrel Cactus.
(1) *Individual barrel cactus would be lost on the landfill and adjacent to the access road, and may be impacted during rail line repair and maintenance.* Cacti occurring within the 644-acre preserved, open space area would be protected along with other sensitive species occupying that area. Additionally, as with Alverson's foxtail cactus, the biological monitor observing rail line repair and maintenance shall know how to identify barrel cactus and will ensure that impacts to this species are minimized and, preferably, avoided during repair activities.

Impacts to this species were considered not significant.

California Ditaxis, Desert Unicorn Plant, and Crucifixion Thorn.
(1) *Where these species occur or suitable habitat is present, impacts may include loss of individual plants, populations, or habitat.* Where found on the landfill in significant aggregations, CMBC recommends that the biological monitor accurately describe the population according to standards of the California Native Plant Society and submit the information to them, including the acreage of suitable habitat and number of individuals that would be lost. MRC should also consider having the biological monitor contact botanists with the California Native Plant Society, Department, and Service prior to disturbing the population and give them an opportunity to study and/or salvage the populations before they are disturbed. Horticulturists with Tree of Life Living Nursery and Santa Ana Botanic Gardens may also be contacted to see if any of the species may be salvaged prior to ground disturbances. These latter organizations specialize in propagation of native species, and Santa Ana Botanic Gardens is known, in part, for its work with special-status plant species, their propagation, and re-establishment in protected areas. Botanists or other concerned individuals at Joshua Tree National Park may be contacted and given an opportunity to study and/or salvage plants that would be lost during landfill operations.

(2) The biological monitor working with repair and maintenance crews along the rail line shall be able to identify these and other sensitive plant species that may occur in the area. When found along the rail line during repair and maintenance activities, the location of the population should be mapped and the population characterized to California Native Plant Society standards. CMBC recommends that these observations be submitted to the Sacramento office of CNPS. This information should be maintained by MRC so that known locations of the plants could be considered during future rail line construction activities. As with Orocopia sage, desert tortoises, nesting birds, etc., the monitor shall work with the construction supervisor to avoid or minimize impacts to these species as much as possible.

Impacts to this species were considered not significant.

Orocopia Sage.
(1) *Impacts include potential loss of individuals from areas adjacent to the rail line.* Although impacts to Orocopia sage are considered not significant, the earlier EIS/EIR (USDI Bureau of Land Management and Riverside County 1992) and Record of Decision (USDI Bureau of Land Management 1993) proposed the following measures for Orocopia sage: Mitigation will include avoidance of these plants by narrowing the disturbance corridor near the population to as small an area as possible. Prior to construction activities in the vicinity of Orocopia sage populations, an on-site meeting between the construction supervisor and the qualified biological monitor shall take place to delineate specific areas to avoid and areas where unavoidable impacts can be minimized. This may include flagging individual shrubs for avoidance. Maintenance and construction staging areas will avoid areas containing Orocopia sage populations. Roads shall be kept to their current widths. Measures shall be taken to alert employees to avoid off-road travel and other habitat disturbances in the areas where this sage is found.

Impacts to this species were considered not significant.

<u>Fish, amphibians, and reptiles.</u>

Desert Pupfish. The Service (1992a) has determined that implementation of the following measures would allow the Project to proceed without any jeopardy to the continued existence of pupfish. Appropriate references are given for measures taken from other documents.

(1) *Potential impacts to habitat due to rail accident or major construction.* The Bureau shall ensure that a contingency plan will be in place prior to the movement of a locomotive engine on the rail line. (a) The Bureau shall be the Lead Agency who will coordinate the corrective actions/activities in the event of a derailment. (b) The Bureau shall coordinate the identification of the responsible parties and their roles in the event of a spill or other Project-related activity. The participating parties shall be signatory to the contingency plan.

Mitigation for potential impacts to the desert pupfish will include monitoring during rail line repair/maintenance activities as well as during any emergency cleanup operations. All monitoring will be conducted by a qualified biologist, [who] will be on-site whenever any maintenance work is conducted in or near desert pupfish habitat. If train operations affect the habitat, corrective actions will be developed by MRC in consultation with the Service, the Bureau, and the Department. Plans for construction or major maintenance will be reviewed by the Service and the Department. In the event of a rail accident in the vicinity of desert pupfish habitat, a qualified biologist will be included as a response and cleanup team member. The Service, Bureau, and Department will be notified immediately (same day). Cleanup operations will be monitored by the biologist so that additional adverse impacts are not incurred by the cleanup operation.

(2) *Potential impacts to water quality and possible direct kills of fish using habitat under the trestle during maintenance and construction activities.* If maintenance of the trestle in the Salt Creek tributary must occur, mitigation measures shall be incorporated into the Project plans to reduce potential impacts to desert pupfish. Storage and staging areas shall be placed in locations which will not affect the habitat, and measures to avoid any discharge of pollutants will be incorporated. Refueling equipment shall be maintained at the junction of the Eagle Mountain rail line and the main tracks (California Department of Fish and Game 1994b). Prior to each passage of a locomotive engine over the rail line, an inspection of the fuel and lubricant holding tanks shall occur. All leaks shall be fixed prior to passage over Salt Creek. A log of all such inspections shall be kept and provided to the Bureau or Service upon request. A non-porous material or other suitable material or structure capable of containing petroleum products shall be incorporated into the rail line at the Salt Creek trestle. The integrity of this material shall be inspected on a daily basis to help prevent the possibility of petroleum products from entering Salt Creek. Drainage shall be established so runoff from the trestle or adjacent rail line does not enter desert pupfish habitat. In the vicinity of desert pupfish habitat, all weed and plant removal shall be done by hand. No herbicides will be used in the vicinity of desert pupfish habitat.

(3) *Potential loss of individuals and less than one acre of degraded habitat, particularly during the fall.* If construction is required on the trestle or rails crossing the tributary, construction plans shall include designs and specifications that will avoid impacts to desert pupfish, including prohibition of construction during the fall when pupfish populations are most restricted and vulnerable. Measures to restore pupfish habitat in Salt Creek and its tributary in the event of an accident will be incorporated as part of the response plan. This will include removal of any portion of the streambed that is contaminated, and the placement of a similar-type clean fill material such that the hydrology of the stream is not altered. If an accident causes the loss of the local pupfish population, the habitat will be restocked with pupfish of the same genetic strain, as provided for in the next paragraph.

As per the State 2081 incidental take permit (California Department of Fish and Game 1994b) MRC will cooperate with the Department and researchers at the Deep Canyon Reserve operated by the University of California ("University") to establish an experimental population of the Salt Creek pupfish at that facility. Provided that the Department has secured all necessary state and federal permits required to remove pupfish from Salt Creek and establish the population at the Deep Canyon Reserve, and provided further that the Department has secured the written consent of the University to construct the pool and establish the population therein, MRC shall, commencing 36 months after the start up of its operations at the Eagle Mountain landfill, pay to the University a sum not to exceed $45,000, to construct and appropriate pool to accommodate an experimental pupfish population at the Deep Canyon Reserve.

As per the Bureau's Record of Decision (USDI Bureau of Land Management 1993), data from ongoing Department surveys of pupfish in the Salt Creek drainage will be assessed to determine whether railroad operations are affecting pupfish.

(4) *Special precautions to avoid impacts to pupfish.* All employees associated with the landfill will participate in a desert pupfish education program. The program will be developed by the Project Proponent prior to implementing all authorized activities. Employees will be advised of the potential impact to the desert pupfish and the potential penalties for taking an endangered species. The content of the education program will be submitted to the Bureau for review at least 30 days prior to the presentation of the program to employees. At a minimum, the program will include the following topics: occurrence of the desert pupfish and its general ecology, sensitivity of the species to human activity, legal protection for desert pupfish, penalties for violations of federal and state laws, reporting requirements, and Project features designed to reduce the impacts to the species and promote its long-term survival.

All requirements given in the streambed alteration agreement (California Department of Fish and Game 1994c) as they relate to avoidance of impacts to desert pupfish shall be implemented by the Project Proponent.

(5) *Reporting and reinitiation requirements.* The Service's Carlsbad office (619-431-9440) must be notified within three working days should any listed species be found dead or injured in or adjacent to the action area. Notification must include the date, time, and location of the carcass, cause of death or injury, and any other pertinent information. In the event that the Bureau suspects that a species has been taken in violation of the terms and conditions contained within the Biological Opinion, such situation shall be reported to the Service's Division of Law Enforcement, Torrence, California at (310) 984-0062.

As per the Biological Opinion, one (1) desert pupfish may be taken due to direct and indirect effects of the action. If, during the course of the action, more than one pupfish is taken, the Bureau must reinitiate consultation with the Service immediately to avoid violation of section 9 of the Act. Operations must be stopped in the interim period between the initiation and completion of the new consultation if it is determined that the impact of the additional taking will cause the irreversible and adverse impact on the species, as required by 50 CFR 402.14(i). The Bureau should provide an explanation of the causes of the taking.

In addition to existing mitigation measures, CMBC recommends that the following measures become part of the Project description and be implemented to protect pupfish and their habitat.

(1) Should the Department be unable to census pupfish populations in Salt Creek downstream of Eagle Mountain railroad due to lack of funds, MRC shall provide sufficient funds and/or qualified personnel to continue censusing the population nearest the rail line. This requirement shall be part of the contingency plan required by state and federal regulatory documents. The goal of this measure is to ensure that the population is not being unduly affected by indirect, unknown impacts associated with reactivation of the rail line. Should the Department discontinue its censusing of pupfish, it is still the responsibility of MRC, as per other measures, to know if the pupfish population has been extirpated and initiate measures to reintroduce them into appropriate habitat if pupfish have disappeared. Therefore it is incumbent upon MRC to ensure that the Salt Creek population that may be affected by the rail line continue to be censused.

(2) The refugium constructed at Deep Canyon Reserve shall be sufficiently large and contain sufficient numbers of pupfish that, should the population be lost from Salt Creek due to train derailment or other, demonstrable Project-related activities, there will be a sufficient number of pupfish in the refugium to (a) restock Salt Creek, as required by the Department (California Department of Fish and Game 1994b), and (b) still have "sufficient" breeding stock in the refugium following the restock of Salt Creek for the refugium to be functionally maintained. The University, Department, and/or other knowledgeable individuals will determine the appropriate number of pupfish to accomplish this goal and ensure that this consideration is a part of the refugium design and plan of operation.

(3) Although the duration of these measures is implied for the life of the Project, such is not stated in any of the regulatory documents. Therefore, herein CMBC states that the mitigation measures given herein and in the state (California Department of Fish and Game 1994b) and federal (USDI Fish and Wildlife Service 1992a) documents for this Project be in force from henceforth and remain in force until the last train trip that transports refuse to the landfill.

CMBC concludes that implementation of these measures would reduce the impact to a level of not significant.

Desert Tortoise. The Service (1992a) proposed terms and conditions for the Project that would avoid or minimize impacts to tortoises during construction and operation of the landfill, access road, and rail line, and concluded that the tortoise would not be jeopardized if these measures were implemented. These measures are reiterated in the Record of Decision (USDI Bureau of Land Management 1993) and state incidental take permit (California Department of Fish and Game 1994b), and stated as follows.

(1) *Landfill-induced increase in the local/regional raven population and concomitant increase of predation of juvenile tortoises, including tortoises in Joshua Tree National Monument.* At the end of each working day, all trash shall be covered with a minimum of 15.24 cm (six inches) of dirt/mine tailings. Furthermore, the active portion of the landfill shall be fenced to aid in controlling wind-blown trash. To mitigate potential increases in Common Raven populations from the presence of trash at the landfill site, a Common Raven monitoring program shall be conducted for the life of the Project. This includes a minimum of two years of preparation and post-closure monitoring. Monitoring shall continue throughout the life of the Project or until the agencies (i.e., the Bureau and Service) determine that it is no longer necessary. Moreover, the Bureau shall ensure that the Common Raven population along Eagle Mountain Road shall be regularly monitored as part of the Project-wide monitoring program. A Common Raven monitoring program will also be established along the rail line. If the regional raven population is found to increase due to landfill activities, then an active raven control program shall be instituted. An active raven control plan, along with appropriate depredation permits, shall be developed and in place before use of rights-of-way begins. The raven control program will include one or more of the following control measures: nest destruction, poisoning, shooting, alteration of landfill operations, or any other measures the responsible agencies deem appropriate.

The application of methyl anthranilate has been recommended/proposed to deter raven use of the landfill refuse. Experiments have been conducted using this Food and Drug Administration approved food additive (i.e., grape flavoring) as a bird repellent on food crops and turf (Cummings et al. 1991a, Cummings et al. 1991b after RECON 1991a). Exact concentrations and spray mediums need to be determined through a testing program. The active portion of the landfill will be fenced to aid in controlling wind-blown trash. The fencing is also intended to reduce the ability of other wildlife species such as coyote and kit fox to gain access to the trash.

(2) *Potential loss of tortoises and burrows during repair and/or maintenance activities along the rail line.* While in or adjacent to desert tortoise habitat and outside of areas cleared of desert tortoise and enclosed by a desert tortoise-proof fence, operators shall inspect under all vehicles, equipment, and supplies for desert tortoise prior to their movement. All staging areas shall be clearly marked. No habitat damaging activity shall be permitted outside of these designated areas. The Bureau shall ensure that a preconstruction survey for desert tortoise shall be conducted within one week of commencement of construction and/or maintenance activities for each portion of track to be repaired. All occupied burrows within 30 m of the track shall be examined for the presence of desert tortoise and conspicuously marked by a qualified biologist. These burrows shall be inspected on a daily basis during construction and/or maintenance activities that could cause their collapse. Any occupied desert tortoise burrows that collapse during repair and maintenance activities shall be immediately excavated and the desert tortoise translocated to an artificial burrow the minimum distance necessary to ensure protection. Any above-ground desert tortoise found within harm's way along the rail line corridor during repair procedures shall also be translocated the minimum distance necessary to ensure its safety. Removed desert tortoises shall be placed off the rail line berm. All desert tortoise that are found within the immediate vicinity of the tracks shall be moved off the tracks the minimum distance necessary to ensure their safety. These animals shall be placed in the shade of a shrub on the side of the tracks which corresponds with the direction in which they were travelling.

(3) *Loss of tortoises due to trains.* The Bureau shall ensure that ballast or other suitable material is placed within the railroad tracks to facilitate movement of desert tortoises out of the interior of the tracks. These areas shall be distributed every 30 m along the rail line while within Bureau designated Category I and II desert tortoise habitat and shall contain at least six linear meters of ballasts. These areas shall be distributed every 91 m while in Bureau designated Category III or non-designated desert tortoise habitat. These areas shall be inspected monthly during the months of March through September and repaired immediately (i.e., prior to the next monthly inspection). The Bureau shall ensure that each train trip between February 1 and October 31 shall be preceded by a qualified biologist to survey and remove any desert tortoise found on or adjacent to the rail line. This monitoring/protection program shall be conducted for a minimum of three years.

The Biological Opinion allows for the removal of 160 tortoises on an annual basis, and the accidental death of one tortoise per year for the life of the Project. If either one of these limits is met, all landfill operations that may take tortoises must stop, the Service must be contacted, and consultation must be reinitiated. During reinitiation of consultation, the Service and Bureau would determine the reason for meeting the take limit, revise the limits as necessary, and determine other appropriate measures that must be implemented to avoid meeting the revised take limit.

(4) *Tortoises adjacent to the tracks subject to increased stress due to noise and vibration of passing trains.* The Bureau shall ensure that a long-term desert tortoise monitoring program shall be instituted that will monitor changes in the populations as the Project proceeds. The intent of the monitoring program is to detect the long-term effects on the desert tortoise population from both direct and indirect impacts associated with the Project. This program shall be approved by the Service and the Bureau. The program shall include two years of preconstruction monitoring.

(5) *Fragmentation of tortoise habitat on either side of the tracks by reactivating the rail line.* The Bureau shall ensure that where culverts are needed to provide for flood flows, their size shall be such as to allow unobstructed movement of desert tortoise under the railroad tracks. The mouth of the culverts shall be tied into the natural terrain to facilitate unobstructed movement of desert tortoise under the railroad tracks. Tortoise-proof barriers, if found to be needed by the Service, shall be placed parallel to the tracks and oriented to guide tortoises to the culverts. The Bureau shall ensure that new culverts shall be placed in areas where current tortoise use of the railroad track berm is concentrated. The design of all barriers

and culverts, and their locations, shall be approved by the Service and the Bureau. Culverts shall be monitored for indication of desert tortoise use. The culverts shall be monitored regularly and kept clear of obstructions for the life of the Project. These culverts shall be monitored yearly (prior to each spring's desert tortoise activity period) and corrective action taken (prior to each spring's desert tortoise activity period) to maintain an unobstructed path for desert tortoises through the culverts. Immediately following storm events, during the desert tortoise's activity period, all culverts shall be inspected and repaired as necessary to maintain an unobstructed path to this animal's movement. The monitoring data shall be evaluated to determine which areas warrant placement of a barrier/culvert system. Exact locations and designs of barriers and culverts shall be selected in the field with the direction of Service, Bureau, and Department personnel.

(6) *Loss of 150 acres due to improvements to Eagle Mountain Road and potential fragmentation caused by the road.* To mitigate for direct impacts to 150 acres of desert tortoise habitat, the Bureau shall receive 375 acres [2.5:1] of desert tortoise habitat from Kaiser.

A tortoise-proof fence shall be placed on either side of Eagle Mountain Road. Fencing shall result in a non-breachable barrier and its support structure may be comprised of a variety of materials. Galvanized hardware cloth of 3 mm (1/8 inch) diameter, or smaller, shall be used along the base of the fence and be buried 61 cm (24 inches) underground and extend at least 46 cm (18 inches) above ground. Where burial is not possible, the bottom half of the fence shall be laid flat on the ground, opposite the road, and secured in a way which prevents desert tortoise from gaining access to the road. This fencing shall be tied into the culvert/bridge system so that desert tortoise moving along the barrier will be passively guided to safe passage points under the road. This fencing shall be monitored yearly (prior to each spring's desert tortoise activity period) and corrective action taken (prior to each spring's desert tortoise activity period) to maintain the integrity of the barrier to desert tortoise. In addition, following storms, the integrity of the fence shall be determined and repaired immediately if found to be damaged. In washes and other areas susceptible to flash-flooding events, "break away" tortoise fabric may be installed. These segments will be loosely tied to the fence on higher ground, permitting them to "break away" in the event of substantial surface flow.

Prior to construction or maintenance activities, a desert tortoise survey shall be completed. All desert tortoise found within the impact area shall be removed. All surveys shall be consistent with Service protocol (1992b). For desert tortoise found within the impact area of the road alignment, if an existing burrow of the correct dimensions is not available, an artificial burrow shall be constructed outside of the road alignment and the animal shall be released at that site as soon as the exclusion fence is in place. Artificial burrows shall be approximately 1.5 m long and 0.6 m deep at the distal end. The angle of decline for the burrow floor shall not be more than 20° from the mouth to the distal end of the burrow. Other burrow dimensions may be used as deemed appropriate by a desert tortoise expert with prior Service approval. If a desert tortoise is present, the appropriate party permitted to handle desert tortoise shall be summoned to remove the animal from harm's way per the terms and conditions of this Biological Opinion.

An authorized biologist (a professional biologist with demonstrated experience with desert tortoise involving techniques to locate desert tortoise and their sign, including correct tortoise handling) shall be present on-site during the clearance survey(s). This biologist should have experience in marking (acrylic paint/epoxy technique) desert tortoise for future identification. Only persons authorized by the Service under the auspices of this Biological Opinion shall handle desert tortoise. The authorized person(s) shall be approved by the Service prior to the onset of activities that would impact desert tortoise. The Bureau/Project Proponent shall submit the name(s) and credentials of the person(s) that will handle desert tortoises to the Service for review and approval at least fifteen (15) days prior to the onset of activities.

Tortoises that are encountered in the summer shall be held until temperatures have dropped to or below 90°F and then released at the relocation site at an empty burrow or an artificial burrow after appropriate information (i.e., weight, length, width, height, sex, apparent health, and identification number) has been collected. These animals shall not be held more than 24 hours. Desert tortoise found during the winter shall be held and isolated from other desert tortoise by containing them in individual cardboard boxes and kept in a cool place, yet protected from freezing temperatures, until the following spring at which time they shall be released at the relocation area after the required information is collected. The release site shall be next to an empty desert tortoise burrow or an artificial burrow and the animal shall be placed in the shade of a shrub. Under certain circumstances (i.e., episodes of warm weather), with prior Service approval, desert tortoise removed from harm's way during the winter may be released and not held for the duration of the winter.

Desert tortoise that are handled shall be marked for future identification. An identification number (using the acrylic paint/epoxy technique) shall be placed on the 4th costal scute (Desert Tortoise Council 1994). Additionally, a 35mm photograph (slide) of the carapace, plastron, and the 4th left costal scute will be taken. Notching is not authorized. All desert tortoise that are handled shall be marked using epoxy and a tag which incorporates the Service's consultation number for this Biological Opinion (i.e., 1-6-92-F-39) and an individual specific identification number.

Culvert passage areas shall be provided at least once every mile. These culvert passage areas shall be placed along Eagle Mountain Road from the intersection of Interstate 10 and Eagle Mountain Road north along a distance of approximately 7.3 km (4.5 miles). A minimum of four crossings, comprised of a minimum of three culverts each (each culvert being no smaller than 46 cm (18 inches) in diameter), shall be provided. If desert tortoise are found not to make use of the culverts under Eagle Mountain Road, then other measures shall be developed as necessary. This may include the construction of several low bridges over the washes to facilitate movement of desert tortoise across this barrier. If monitoring shows an additional need for culvert crossings further north along Eagle Mountain Road, they shall be installed within one year of that determination.

(7) *Increased number of road-killed animals and concomitant increase of available food for tortoise predators, such as ravens and coyotes.* MRC will be responsible for removing road-killed animals from along Eagle Mountain Road to reduce the attraction of ravens and other potential desert tortoise predators to the area. This activity will occur daily or as necessary to ensure that animals are not left on or alongside the road.

(8) *Increased potential for vandalism and illegal collection of tortoises;* (9) *Increased potential for off-highway vehicle use in the area resulting in loss of tortoise burrows and increased number of tortoises being crushed;* (10) *Increased potential for the release of captive, diseased tortoises into the wild thereby exposing healthy, wild tortoises to Upper Respiratory Tract Disease.* Most of these impacts are expected to be avoided by educating construction workers, Townsite residents, and other pertinent individuals on tortoise issues as required by the Service (1992a): All landfill associated employees shall participate in a desert tortoise education program. The program shall be developed by the Project Proponent prior to implementing all authorized activities. Employees shall be advised of the potential impact to the desert tortoise and the potential penalties for taking a threatened species. The content of the education program shall be submitted to the Bureau for review at least 30 days prior to the presentation of the program to employees. At a minimum, the program shall include the following topics: occurrence of the desert tortoise and general ecology, sensitivity of the species to human activities, legal protection for desert tortoises, penalties for violations of federal and state laws, reporting requirements, and Project features designed to reduce the impacts to desert tortoises and promote the species' long term survival.

A Desert Tortoise Procedure Card (to be distributed to all employees) shall be developed to reflect the measures necessary to comply with the threatened status of the desert tortoise. The card shall reflect the current status of the desert tortoise and the prohibition of take. The card shall identify the person(s) authorized to handle this species.

(11) *Changes in water flow patterns that may result in occasional flash floods that would impact tortoise habitat to the east of the landfill.* RECON (1991) did not consider this impact to be sufficiently important to warrant any specific mitigation measures. However CMBC found tortoises residing south and east of the existing mine, and has proposed new measures to address this potential impact (see (b) below).

(12) *Reporting and reinitiation requirements.* If the Project Proponent fails to comply with the reasonable and prudent measures or any of the terms and conditions of this Biological Opinion, the Bureau shall suspend the rights-of-way for the proposed action until such time that the Proponent is in compliance with these terms and conditions. The Bureau shall also notify the Proponent at that time that failure to comply will lead to revocation of their rights-of-way.

The Project Proponent shall designate a field contact representative (FCR) who will be responsible for overseeing compliance with protective measures for the desert tortoise and for coordination and compliance with the Bureau's stipulations. The FCR shall have the authority to halt all associated Project activities which may be in violation of the stipulations.

The biologist shall provide a full report to the Bureau and Service of all desert tortoise which are found and moved from harm's way. This information shall include: (a) the locations (narrative and maps) and dates of observations; (b) general conditions and health, and apparent injuries and state of healing, and whether animals voided their bladders when handled; (c) locations moved from and locations moved to; (d) diagnostic markings (e.g., identification numbers or previously marked lateral scutes). The report shall be submitted within 30 days to the Service following the first desert tortoise activity period which coincides with rail line activity.

The Service's Carlsbad Office (619-431-9440) must be notified within three working days should any listed species be found dead or injured in or adjacent to the action area. Notification must include the date, time, and location of the carcass, cause of death or injury, and any other pertinent information. In the event that the Bureau suspects that a species has been taken in violation of the terms and conditions contained within this Biological Opinion, such situation shall be reported to the Service's Division of Law Enforcement, Torrence, California (310) 984-0062.

(13) *Unforeseen, adverse direct and indirect impacts to the local and regional, desert ecosystem.* "The owner/operator of the Eagle Mountain landfill shall pay $1 per ton of nonhazardous municipal solid waste deposited at the landfill into a trust or nonprofit corporation established by the County of Riverside which shall expend those funds to preserve and enhance biological, scenic, and cultural resources in Riverside County, particularly in the desert regions of eastern Riverside County by acquiring, restoring, maintaining, and protecting open space lands or interest in lands, water, or water rights and wildlife habitat, and by providing limited public access to those lands, and by supporting research regarding the ecology of the desert and the effects of the landfill Project upon the desert ecology and education concerning the preservation of desert natural resources including, but not limited to, research, education, and monitoring activities conducted by the Bureau, the Service, and the National Park Service" (Selzer 1992).

In addition to the mitigation measures given in the Biological Opinion, which are listed above, CMBC recommends that the following mitigation measures be incorporated into the Project's plan of operations.

(1) *Potential for fire created by reactivating the rail line and the increased incidence along the access road.* MRC shall develop a contingency plan that will address the potential for Project-related fire along Eagle Mountain access road and the rail line. A list of phone numbers of all local fire departments should be made available to all waste haulers and train operators, and a system identified that would result in the quickest response to any fires observed in the area. Although it would be difficult to differentiate between Project-related and non-Project-related fires along Kaiser Road, the contingency plan should facilitate extinguishing any such fires, protect adjacent resources, and provide an immediate benefit to the local community.

(2) *Potential loss of tortoises and tortoise-occupied habitat south and east of the proposed landfill footprint.* No Project-related ground disturbance shall occur east or south of the landfill footprint without prior, focused surveys for tortoises. Prior to any Project-related ground disturbances on the eastern and northeastern parts of Phase 4, there shall be focused tortoise surveys to remove tortoises from harm's way. Any tortoises thus removed shall be placed on the nearest lands owned by MRC that are not to be impacted. Up to 160 tortoises can be handled yearly under the existing Biological Opinion, including any that are removed from the landfill. The Biological Opinion only allows for the loss of 150 acres of tortoise habitat from along the Eagle Mountain access road, which would be compensated by the purchase of 375 acres of manageable tortoise habitat elsewhere. Therefore, any tortoise habitat lost during landfill operations is not covered in the Biological Opinion.

If landfill operators (all of which should be familiarized with tortoise occurrence in the area as per the requirement for a tortoise education program) or biologists find tortoises within impact areas on the landfill during focused surveys, that information shall be reported to the landfill's environmental coordinator or subcontractor and the Service contacted. If tortoises are found, they would be transported to the nearest, adjacent area, on MRC lands, outside all phased development. All tortoises, regardless of where they are found, would be handled as per the requirements of the Biological Opinion (USDI Fish and Wildlife Service 1992a). For tortoise habitat, if any, that is lost to the expanding landfill footprint, the qualified biologist shall determine the acreage and provide that information to the Service in applicable reports. The Service will then determine if additional compensation is required.

Based on field surveys by both RECON and CMBC, it is our conclusion that the rocky, steep terrain of the proposed landfill site is not occupied by tortoises. They do occur in one, and likely several, canyons on the eastern portions of the existing mine. Regardless of previous survey findings and our conclusion, tortoises occurring on any of the landfill phases are still protected by state and federal Endangered Species Acts. Therefore if tortoises are ever observed on the landfill, that information shall be reported immediately, and MRC shall work with the Bureau and Service to mitigate impacts as necessary.

(3) *Impacts associated with Common Ravens.* CMBC recommends that the following information be considered and pertinent measures adopted as part of landfill operations to further minimize the likelihood that raven populations will increase in the area. FaunaWest (1989) noted that differences in management practices at landfills appeared to affect the level of use by ravens. Practices that did not favor ravens included: (a) upslope burial of trash, as opposed to downslope burial; during upslope burial, the bulldozer gradually backs away from the developing slope, rather than moving over it to the fresh face and exposing previously buried trash, as in the downslope process; and (b) more frequent burial of trash.

Boarman (1992) has listed measures that are intended to avoid an increase in raven numbers at landfills. Some of these measures have already been recommended elsewhere, and are included herein to provide a complete summary of the measures recommended by Boarman: (a) Use upslope burial or other equally efficient methods to build cells and cover garbage. (b) Cover refuse several times each day rather than at the end of the day or several times each week. (c) Cover refuse with at least 15.24 cm (six inches) of fill at the end of the day, or more if needed to ensure 100% coverage overnight [already proposed]. (d) Coyote-proof perimeter fence to prevent this and other potential predators (e.g., kit fox, gray fox, etc.) from digging up trash [already proposed]. (e) Additional cover or other types of cover (e.g., synthetic) if ravens access refuse despite the above measures. (f) Tortoise-proof perimeter fence in tortoise habitat

[i.e., along the eastern boundaries of Phase 4 and 5]. (g) Enclose screening, inspection, and all other areas outside the active cell where refuse may be exposed to ravens. (h) Drain truck-cleaning areas and other pertinent places to prevent buildup of runoff water and refuse. (i) Sewage ponds, leachate ponds, and other water sources must be rendered raven proof. (j) Remove or alter potential perch sites on and near landfills. (k) Test methyl anthranilate, a non-toxic food additive, for effectiveness as a repellent to ravens when sprayed over newly deposited refuse [already proposed]. (l) When closing or making major changes at landfill, time those activities within periods of tortoise inactivity, such as mid-winter or late June, to prevent ravens from taking tortoises as an alternative when food sources at the landfill are unavailable. (m) Take other measures off-site to reduce raven use of organic refuse; e.g., raven proof transfer stations, prohibit residential refuse containers accessible to ravens. And, (n) monitor raven use at landfill sites and monitor changes in regional raven populations [already proposed].

CMBC concludes that implementation of these measures would reduce the impact to a level of not significant.

Common Chuckwalla.
(1) *Loss of individual animals and occupied habitat from the landfill and access road sites, and less so, along the rail line.* Common chuckwalla was not listed as a Federal Category 2 Candidate Species at the time of RECON's technical report (1991) and the issuance of the previous EIS/EIR (USDI Bureau of Land Management and Riverside County 1992), thus impacts to them were not considered and mitigation measures have not been recommended.

Given the expected significant impact to this species, CMBC recommends that preconstruction surveys be performed throughout landfill areas ahead of the expanding footprint. During these focused surveys for chuckwallas, the biological monitor will have an opportunity to look for other sensitive plant and animal species. The monitor will have in his or her possession tools (i.e., crowbar, wedges, etc.) that will facilitate the removal of chuckwallas from the areas of impact before any ground disturbance occurs. The chuckwallas will be marked using techniques currently considered standard and humane for reptiles and placed into adjacent areas outside the impact zone. The biologist will maintain records of the translocated chuckwallas, including a list of assigned numbers and maps showing the locations of the translocated animals. This effort, in part, will help determine the efficacy of translocating chuckwallas out of harm's way and may minimize the loss of individual animals, depending on how well they adapt to being moved.

Given the hierarchal social behavior of chuckwallas, the biologist or landfill employee may choose to salvage and remove only those chuckwallas with a snout-vent length of less than 125 mm, thereby removing and introducing individuals that may be less likely to disrupt the social hierarchy of established orders in adjacent areas. Portions of the Trust Fund should be intended for acquisition of prime chuckwalla habitat, likely on the Chuckwalla Bench, to partially offset the habitat loss on the Project site. Given the potential high cost of this proposed mitigation, it could be possible to train landfill employees to perform the duties outlined above and report their results in appropriate year end reports.

(2) *Potential increased predation from ravens.* Measures given elsewhere to minimize this impact would also benefit chuckwallas.

CMBC concludes that implementation of these measures would reduce the impact to a level of not significant.

<u>Birds.</u>

Birds of Prey, including Northern Harrier, Sharp-Shinned Hawk, Cooper's Hawk, Golden Eagle, Prairie Falcon, and Long-Eared Owl. Although impacts are not considered significant, measures recommended for other species, where significant impacts are expected, will provide an opportunity to implement the following measures.

(1) *Foraging habitat would likely be lost when Eagle Mountain Road is widened and when undeveloped portions of the landfill are disturbed.* Minimizing impacts to tortoises and the loss of tortoise habitat along Eagle Mountain Road would serve to maintain some of the existing foraging habitat that may be used by most of these raptor species. The preservation of 644 acres of open space around the landfill would maintain some foraging habitat that may be used by these raptors. The open space area would also serve as a buffer to adjacent foraging habitats and likely minimize the impacts to those areas so that sensitive raptor species could continue to forage there. Use of the conservation trust fund to obtain and preserve desert ecosystems will likely benefit foraging raptors on a regional level.

(2) *Disturbance from the landfill operation, increased truck traffic on access roads, and reactivation of rail service may impact nesting birds through nest abandonment, lowered reproductive success, and increased stress to adult birds.* During preconstruction surveys on the landfill site and during monitoring along the rail line for tortoises and other special-status species, the biological monitor shall be cognizant of nesting raptors and record any such observations in field notes. Such observations should be reported in the monitoring reports to the regulatory agencies that are required elsewhere for other species and monitoring programs. The report shall include the monitor's observations of impacts, if any, to nesting birds; i.e., did the birds abandon their nests? did the birds appear to be unaffected by construction activities as evidenced by fledgling birds? Where possible, particularly for nesting raptors in the vicinity of the active landfill footprint, the monitor shall attempt to determine if nestlings fledged in areas where construction activities and landfill operations may have disturbed them. Where possible, all nesting raptors shall be avoided by an appropriate buffer to minimize human impacts. When possible, all rail line repair and maintenance activities should occur during the winter, outside raptor and other special-status bird species' breeding seasons.

Impacts to these species were considered not significant.

Western Burrowing Owl.
(1) *Potential loss of owls, including nestlings, and potential increase in owl-vehicle collisions.* During aforementioned preconstruction surveys and monitoring activities, the biological monitor shall survey for burrows occupied by owls, according to standards set by the Department. (These are nearly identical to the Service's protocol for desert tortoise surveys). Such burrows may be occupied by individual resident birds, individual transient birds, or by breeding pairs. Measures shall be implemented to ensure that no owls are buried inside their burrows. The biologist shall be familiar with the biology of Burrowing Owls and be able to determine if burrows are occupied by individual owls or a pair. If the burrow is occupied by a pair, the biologist shall determine, through nonintrusive methods (i.e., by distant observation), if there are eggs or nestlings in the burrow. Such burrows shall be avoided until the nestlings have fledged. As long as individual birds are not buried and nesting efforts not disrupted, there should be sufficient habitat in the region to accommodate birds that are force-dispersed from areas of impact. For rail line maintenance and repair work, existing burrows shall be found, flagged, and avoided.

During removal of road-killed animals, as required for tortoise mitigation, the biologist shall document the time of year and location of any road-killed Burrowing Owls. This information should be reported to the Department in year-end monitoring reports. While this is not a mitigation measure, it will help the Department and other regulatory agencies determine potential impacts for future projects in similar conditions.

Impacts to this species were considered not significant.

Eagle Mountain Scrub Jay.
(1) *Potential loss of scrub jays to ravens or other predators if the predator populations increase in the area in response to the landfill.* Measures have been proposed relative to desert tortoises to avoid an increase in the predator populations, particularly ravens, which may also adversely affect scrub jays (USDI Bureau of Land Management and Riverside County 1992, USDI Bureau of Land Management 1993). Additional measures have been recommended to avoid an increase of ravens should those measures implemented before and during the initial stages of the landfill prove ineffective (see existing and new measures relative to tortoises).

Given that potential impacts are considered to be very unlikely, CMBC concludes that implementation of these measures would reduce the impact to a level of not significant.

Wash-associated resident birds, including LeConte'sThrasher, Loggerhead Shrike, and others, and Migrant Birds, including Yellow Warbler, Yellow-Breasted Chat, and others. While impacts to these species are not considered significant, measures recommended elsewhere for other species will also benefit these wash-associated and migrant species.

(1) *Some wash habitat used by these birds may be lost through the development of the landfill and improvements to the access road, and birds in wash areas along the rail line may be stressed or abandon nesting efforts by repair and maintenance activities.* Migrant birds are often found in wash-associated vegetation, such as occurs within and adjacent to all Project areas. Palo verde washes with desert willow, smoke tree, iron wood, and other large trees and shrubs are particularly important for resting and roosting, migrant species. Every effort shall be made to avoid damaging these communities, particularly during maintenance and repair activities along the rail line.

(2) These wash communities are also important for the birds that may breed in the area, including LeConte's Thrasher and Loggerhead Shrike. During the spring breeding season of these birds, preconstruction surveys for tortoises, plants, and other special-status species shall also focus on locating any breeding thrashers or shrikes. When nesters are found, the biological monitor shall work with the construction supervisor to locate storage and staging areas away from the nests, and to the degree possible, ensure that construction activities do not result in nest abandonment. The biologist shall document observations in field notes, and report pertinent information to the regulatory agencies in one or more of the various reports required for this Project.

Impacts to these species were considered not significant.

Mammals.

Bats, including California Leaf-Nosed Bat, Townsend's Big-Eared Bat, Pallid Bat, and California Mastiff Bat.

(1) *Loss of the main adit at Eagle Mountain Mine is expected in ≈ 35 years.* The following measures were recommended in the original EIS/EIR (USDI Bureau of Land Management and Riverside County 1992). The California leaf-nose bat population at the adit and in the surrounding area would be monitored before landfill operations begin. Monitoring would continue after operations begin, but before activity reaches the adit. To accommodate bat utilization of the mine adit, the mouth of the adit would be extended upward and/or outward using appropriate conduit material to maintain an 2.4 m (eight-foot) diameter opening, the current adit dimension, above any landfill deposits, including the level of the final landfill contour. The conduit material will be relatively impermeable to landfill leachate and gas. If necessary, additional impermeable liners will be employed to assure there is no gas or leachate leakage into the adit extension. The adit entrance would also be gated to allow free exit and entrance of bats, but prevent human intrusion.

Dr. Brown (pers. comm., August 21, 1995) provided CMBC with the following information. She characterizes the proposal to extend the adit opening to allow continued access for leaf-nosed bats as "experimental." However, she states that this measure is preferable to losing the adit altogether. While the Black Eagle adit, if reopened, is a potential substitute as a maternity roost, it lacks the specific characteristics (e.g., appropriate temperatures) required to make it suitable as a winter roost. She also states that monitoring for bat species should occur both in winter and summer months to determine the extent of impacts and use.

Given that monitoring would continue throughout the life of the landfill operation, there would be ample opportunity to determine the occurrence of additional bat species that have not yet been identified. CMBC recommends that MRC work closely with the monitoring biologist to determine any unforeseen impacts and implement mitigation measures as appropriate to avoid further impacts to the bat population in the area.

While these measures may preserve the opening and the adit, it is likely that disturbance associated with the landfill will still result in abandonment of the roost. Given this likely outcome, CMBC concludes that significant impacts may occur in spite of these measures.

American Badger.
(1) *Burrows along the rail line could collapse; there is the potential for road-kill and train-kill; and badgers in the area may be subject to higher stress due to noise, vibration, and human activity.* None of these impacts is considered to be significant, and no mitigation measures are recommended relative to badgers. CMBC recommends that any badgers found during road-kill searches be reported in year-end reports to the regulatory agencies.

Impacts to this species were considered not significant.

Nelson's Bighorn Sheep.
(1) *Loss of permanent and temporary water sources.* As per RECON (1991) and the previous EIS/EIR (USDI Bureau of Land Management and Riverside County 1992), three new, permanent water sources, ensuring year-round water availability, will be placed away from the mine site to encourage bighorn sheep to use the surrounding natural areas rather than the Project site. The creation of new water sources will compensate for the loss of water sources on the landfill site.

A baseline telemetry study is being conducted as per the National Park Service (1993) to determine the best locations for these water sources. New water sources will be placed in ewe home ranges to facilitate their finding them. New water sources will be placed in habitat at least one year before water sources are removed to enable sheep to habituate to the new water sources. Home range studies have been and will continue to be conducted by Dr. Charles Douglas and University of Nevada, Las Vegas (UNLV) to determine current sheep use in the area, and later to determine if the sheep's ranges are expanding to include the new water sources. If not, sheep will be translocated to the new water sources to encourage the incorporation of the water sources into their new home ranges. These new sources will be maintained throughout the 100-year life of the Project, and replaced by the Project Proponent when necessary.

The sites for the water sources and their design will be selected and/or approved by biologists from the Bureau, Department, and UNLV. Steve Torres, of the Department, indicated that he is working with Dr. Charles Douglas to determine the best location of these water sources (pers. comm. 15 August 1995). If they decide that the best locations are on Joshua Tree National Park lands, he indicated that they would work with the Park Service to choose the location and facilitate the placement of the water sources.

Additionally, Buzzard Springs will be rehabilitated and cleared of tamarisk, which will partially compensate for the loss of the temporary water source on the Project site. Since this measure was first recommended (RECON 1991), Buzzard Springs is now found on National Park lands. CMBC expects that MRC will discuss the feasibility of this proposal with Park staff and act accordingly.

The Department has indicated that at least two new water sources developed in the southern Orocopia Mountains could offset impacts to existing water sources, and could reduce the risk of train-kill for sheep possibly moving between the Orocopias and the Chocolate Mountains in search of water (Andrews pers. comm., August 21, 1995). The Proponent should work with the Department to determine the feasibility of developing such sources and determining appropriate locations.

(2) *Loss of ≈ 944 acres of bighorn sheep habitat.* This impact would not be directly compensated, although the placement of new water sources into adjacent areas is intended to expand the available sheep habitat. If the new water sources are used by sheep, adjacent areas, which are otherwise suitable habitat not currently used due to lack of a nearby water source, would become available habitat for sheep displaced from previous home ranges and old water sources within the proposed landfill area. Desert bighorn sheep sometimes show a remarkable ability to acclimate to disturbances. They are regularly seen on the active portions of the limestone mines along the north face of the San Bernardino Mountains (pers. obs.), and have acclimated to aerial gunnery activities in the Chocolate Mountains (Steve Torres, pers. comm., 15 August 1995). Given that landfill activities would begin at the western end of the site and slowly proceed eastward over the next 100 years, sheep habitat would not be lost from the site for many years. Depending on the final cover and other factors, they may continue to use areas to the west as the footprint expands to the east. Appropriate expenditure of the trust fund could also benefit sheep and help offset this habitat loss.

(3) *Increased stress associated with noise, miscellaneous human activities, and domestic pets.* The new water sources will be strategically placed to lure sheep away from disturbances, which should decrease bighorn sheep stress. Approximately 644 acres of potential habitat would remain as natural open space around the periphery of the proposed landfill. This habitat would remain for sheep use and would provide a buffer zone between the landfill operation and the relocated sheep population. Virtually all of this preserved habitat is located on Public (selected) Lands. Expanding sheep range into areas remote from the landfill would decrease the chance of stress-related impacts, and of contact with any potentially toxic substances at the landfill site. All dogs will be confined to fenced yards, or otherwise restrained, to prevent harassment of bighorn in the vicinity of the landfill operation.

(4) *Crowding of animals and introduction of domestic sheep increasing potential for spread of disease.* If the new water sources are accepted, as given in (2) above, the amount of available habitat may increase in areas not currently used. Domestic sheep will be banned from the mine property to prevent disease transmission to bighorn sheep.

(5) *Increased potential for sheep to be poached.* Given sheep's potential to acclimate to human activity, the National Park Service is concerned that sheep would be more vulnerable during landfill operation than they currently are. An employee training program would be implemented and would include a discussion of bighorn sheep habits and habitat needs. This employee awareness program should increase acceptance and knowledge of bighorn, which may help protect sheep residing near the Project. Interested employees could provide useful observational data. Only authorized individuals would be allowed to possess firearms on the property to assure that no poaching of bighorn occurs.

(6) *Potential for train kills and fragmentation of habitat by reactivating the rail line.* RECON (1991) concluded that reactivation of the rail line would not impact bighorn sheep, that no sheep are expected to be injured or killed by moving trains. RECON (1991) did indicate that a significant impact would occur if sheep movement between the Chocolate and Orocopia Mountains was disrupted by regular rail operation, but that there was no evidence that sheep migration was affected by earlier rail operation.

As reported, the Department has monitored the sheep population in the Orocopia Mountains since June 1994, and has documented both rams and ewes crossing Salt Creek, and the rail line, between the Orocopias and Chocolate Mountains. Based on information provided by Torres and Andrews, the following measures are recommended to avoid or minimize impacts to sheep using this travel corridor:

(a) To the degree possible, trains should not stop in the pass between the Orocopias and Chocolate Mountains [a 4.8 to 6.5 km (three to four mile) segment of the 83.8 km (52-mile) long rail]. If trains must stop in the area due to an emergency, they should not sit there idling, but should be turned off, if possible. Nancy Andrews, who is the unit coordinator of the Department for Imperial County and Riverside County south of Interstate 10, indicated that impacts are more likely during the summer when sheep regularly use water sources along Salt Creek (pers. comm. 15 August 1995). Therefore, if possible, maintenance of the rail line should not occur along this pass during the summer.

(b) Trains should proceed through the pass area at the slowest possible speed to reduce noise levels and the likelihood of collisions with sheep.

(c) Measures recommended for tortoises could result in the placement of fences along the rail line, depending on the findings of the three-year monitoring study. Tortoises are more likely to cross the rail line on the Chuckwalla Bench, north of Salt Creek and the sheep travel corridor. Torres recommended that no fences be placed in this pass. If fences are required, they should be designed to exclude tortoises from the rail line but not restrict sheep movement in the area. Prior to placing any fences across this corridor, big horn sheep specialists with, at least, the Department should be contacted to discuss fence placement and design.

(d) MRC could partially offset impacts by providing funds to the Department to facilitate monitoring in the Orocopia Mountains and the western portions of the Chocolate Mountains. This support would facilitate the Department's monitoring of sheep use in the area, and provide a continuing opportunity to assess impacts to sheep using the travel corridor. These data, which would be collected after reactivation of the rail line, would be compared to data collected prior to reactivation to facilitate assessment of the impact.

(e) If any sheep are injured or killed by a train, this information should be fully documented, and the Department contacted within three working days of the accident. The disposition of the injured or dead sheep should be determined in conjunction with Department bighorn sheep biologists. If even one sheep is struck by a locomotive, the Project Proponent should work with these experts to determine which measures, if any, could be implemented to avoid this impact during future train trips.

CMBC concludes that implementation of these measures would reduce the impact to a level of not significant.

Common wildlife and vegetation. There is a comprehensive discussion of "ecosystem effects" in the Draft EIS/EIR. CMBC concludes that common plants and animals occurring in the area would be benefitted by measures intended to protect special-status species and resources, as described below.

(1) *Impacts to native wildlife and plant species with no special status may include loss of habitat and increased human disturbance, increased road-kill on access roads and train-kill on the rail line for many species, possibly including burro deer, antelope and round-tailed ground squirrel, kit fox, desert and Merriam's kangaroo rats, for example. In addition, an increased human presence at the landfill and Townsite may lead to degradation of local habitats from increased off-highway vehicle use, increased predation of native animals by domestic dogs and cats, increased potential for introduction of non-native, invasive plants, such as tamarisk (Tamarix sp.) and giant cane (Arundo donax).* Most of these impacts would be minimized by implementing mitigation measures given elsewhere for special-status species. Measures recommended for bighorn sheep to minimize the human impact of Townsite residents on the local ecosystem will benefit adjacent plant communities; tamarisk would be removed from Buzzard Springs as that site is rehabilitated; the tortoise-proof fence along Eagle Mountain Road would likely minimize impacts to some animals, including reptiles and small mammals; etc. Measures designed to reduce impacts to bighorn sheep in the Orocopia and Chocolate Mountains are likely to benefit burrow deer as well. The tipping fee collected for each ton of refuse is considered a significant benefit to the desert ecosystems of Riverside County.

CMBC concludes that implementation of these measures would reduce the impact to a level of not significant.

Given the complexity of these many mitigation measures, the need to coordinate different activities, and the potential high cost of implementing these measures, CMBC recommends that MRC consider enlisting a fulltime biologist on its staff to facilitate compliance with these environmental documents. The biologist could serve as the Field Contact Representative and liaison between MRC and the regulatory agencies; he/she could be responsible for removing road-killed animals, removing chuckwallas and tortoises from impact zones, monitoring maintenance activities along the rail line, drafting the year-end reports, and overseeing implementation of other mitigation measures. If consultants are used to perform some of the activities, the staff biologist could ensure quality control and coordinate among different entities. This recommendation is precedented by numerous, successful programs where fulltime biologists are employed; e.g., Caltrans, Southern California Edison, Metropolitan Water District, Castle Mountain Mine, American Girl Mine, etc.

Chapter 6
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APPENDIX A

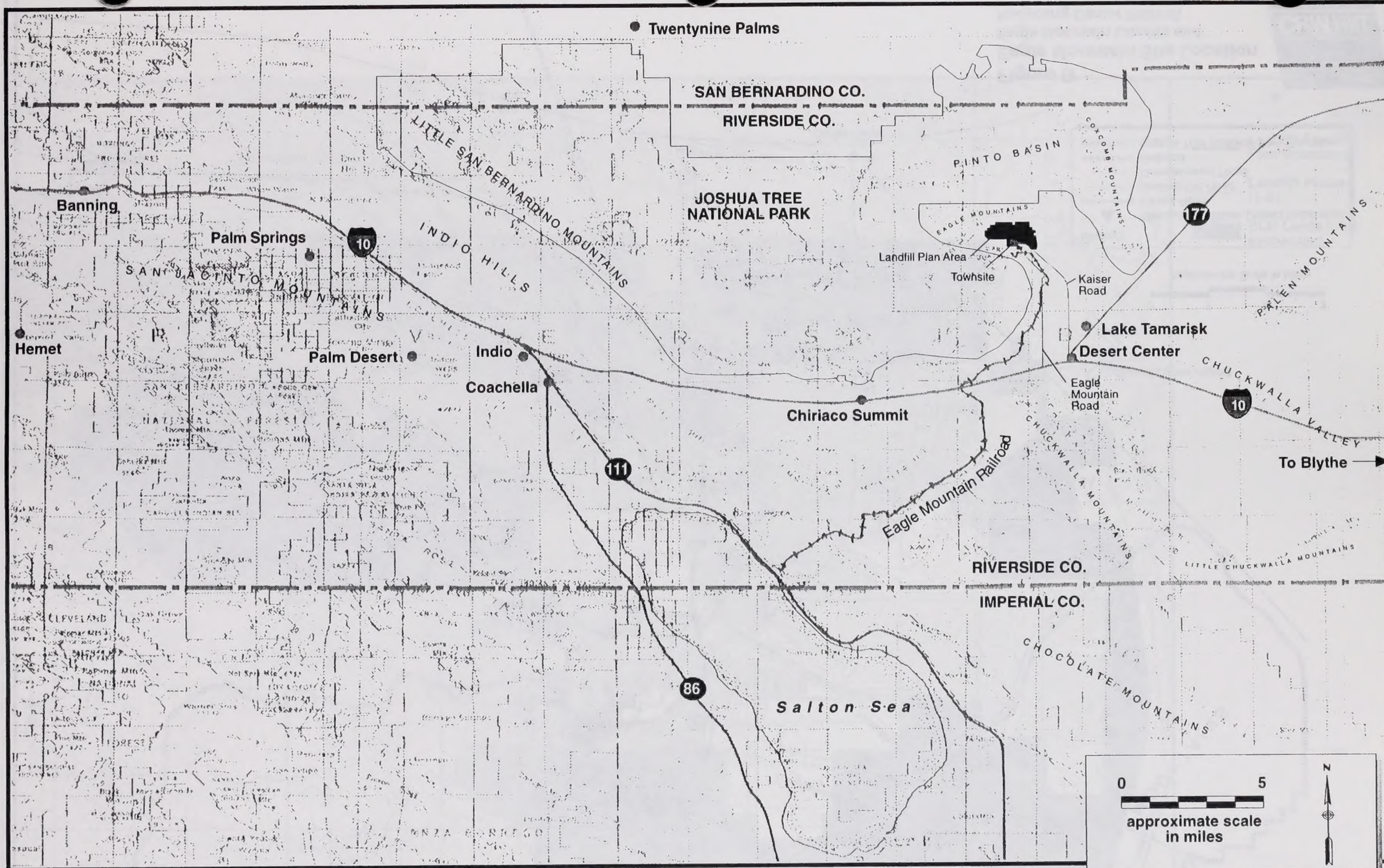

Figure A
Project Location Relative to Eastern Riverside County
Eagle Mountain Landfill and Recycling Center EIS/EIR

CH2M HILL®

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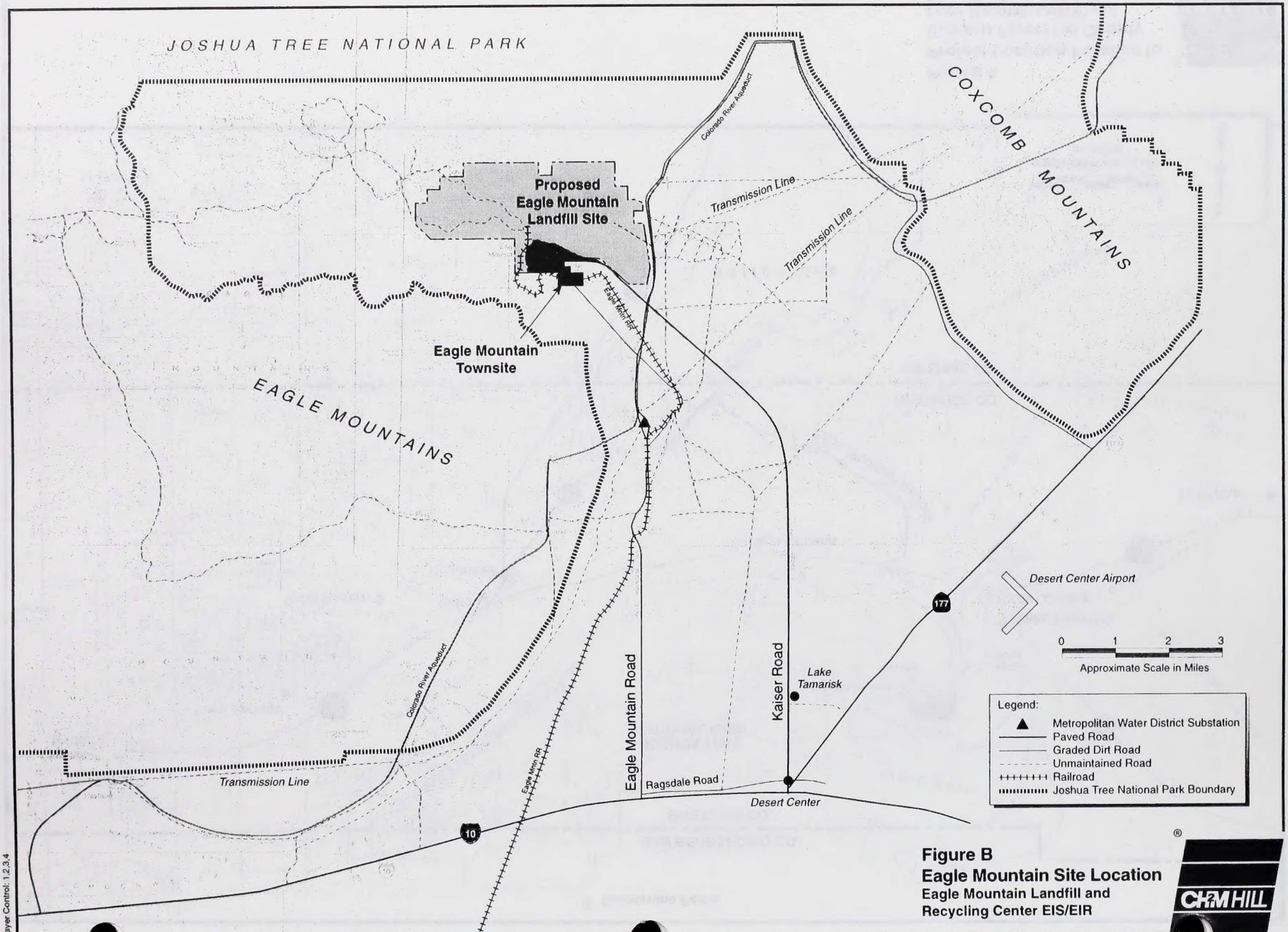

Figure B
Eagle Mountain Site Location
Eagle Mountain Landfill and Recycling Center EIS/EIR

CH2M HILL®

Layer Control: 1,2,3,4

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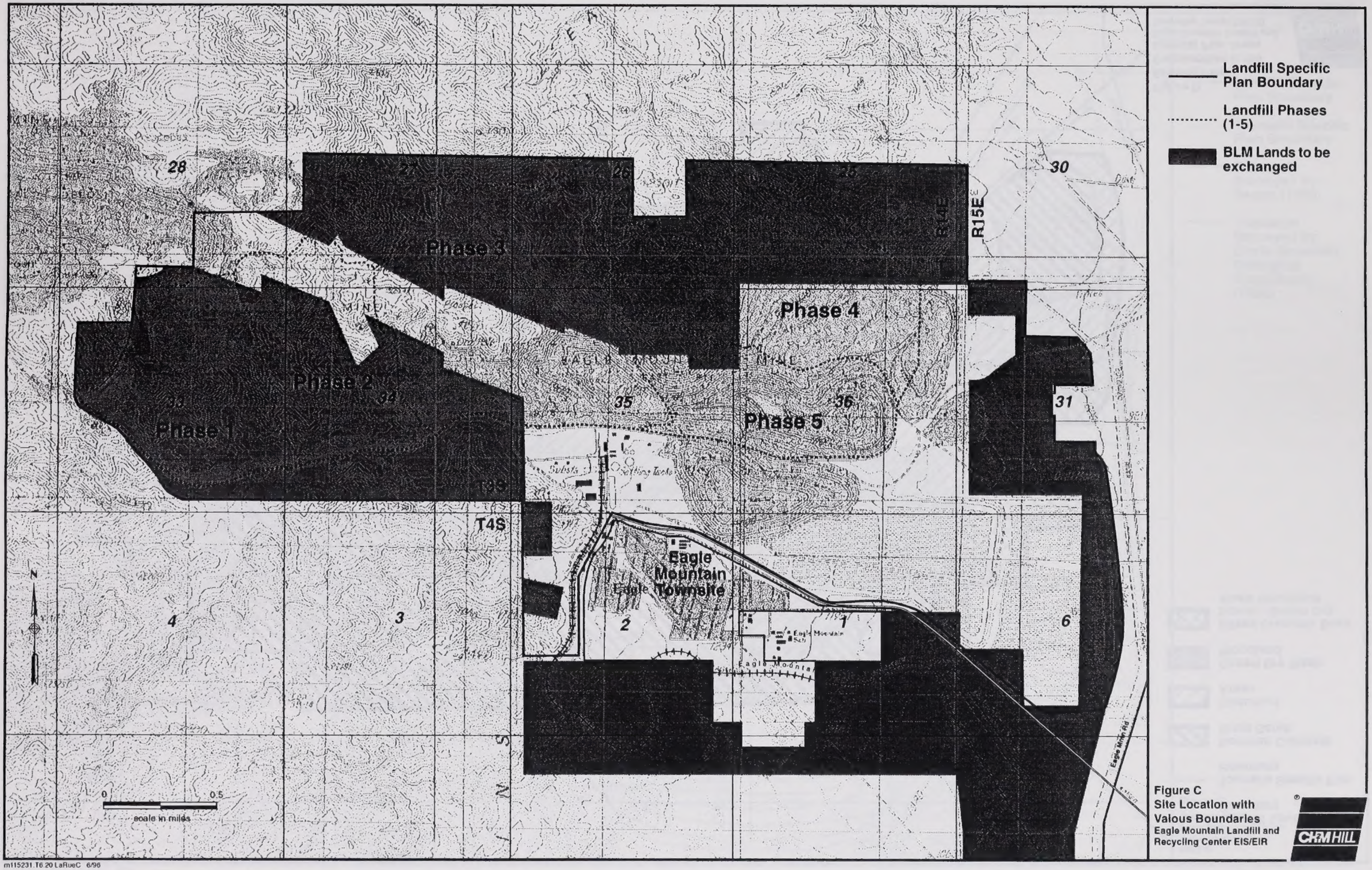

Figure C
Site Location with Valous Boundaries
Eagle Mountain Landfill and Recycling Center EIS/EIR

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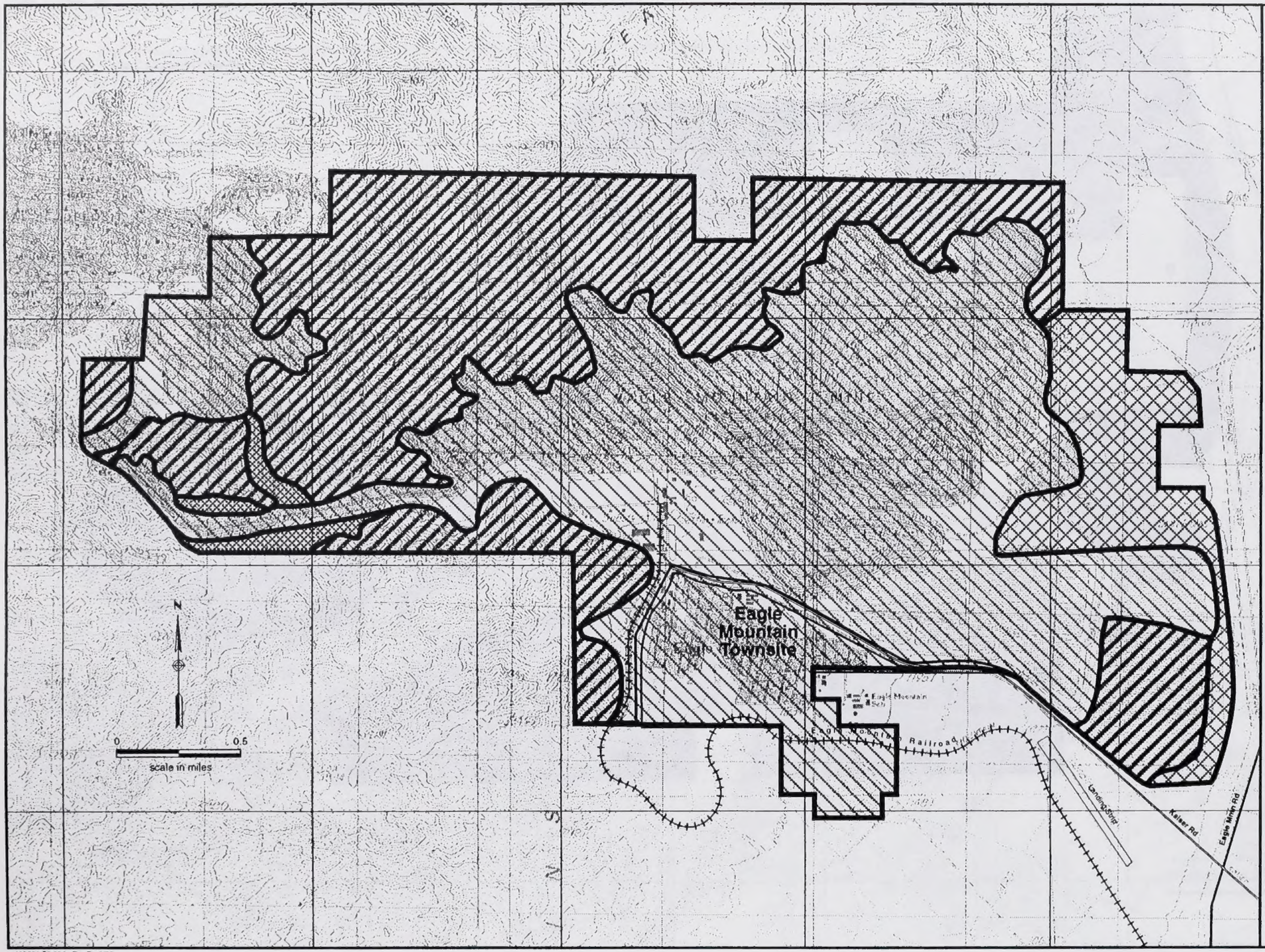

Landfill Specific Plan Boundary

Townsite Specific Plan Boundary

Sonoran Creosote Bush Scrub

Disturbed Areas

Desert Dry Wash Woodland

Mixed Creosote Bush Scrub - Desert Dry Wash Woodland

Figure D
Existing Plant Communities in the Specific Plan Areas
Eagle Mountain Landfill and Recycling Center EIS/EIR

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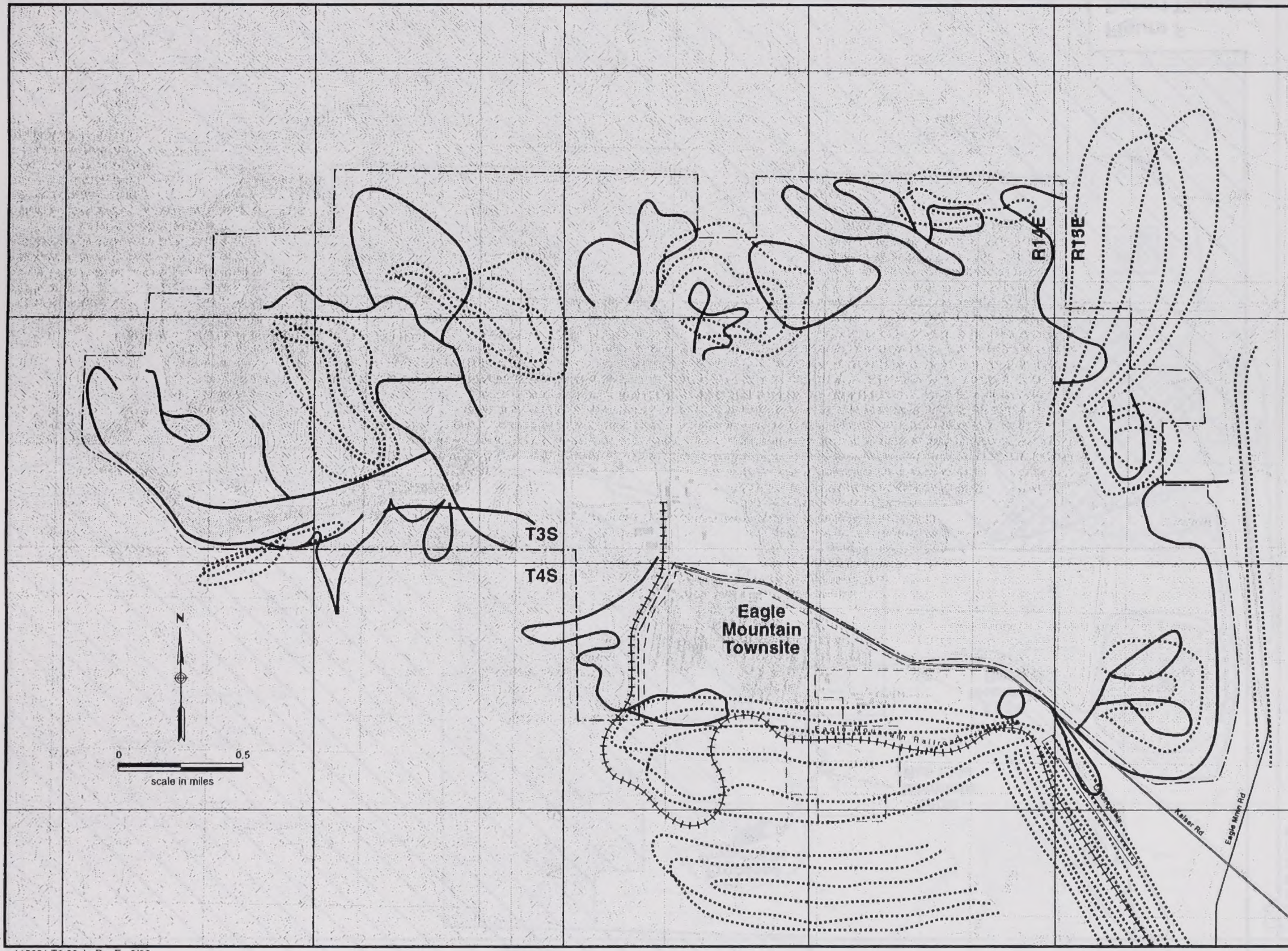

Figure E
Survey Routes
Eagle Mountain Landfill and Recycling Center EIS/EIR

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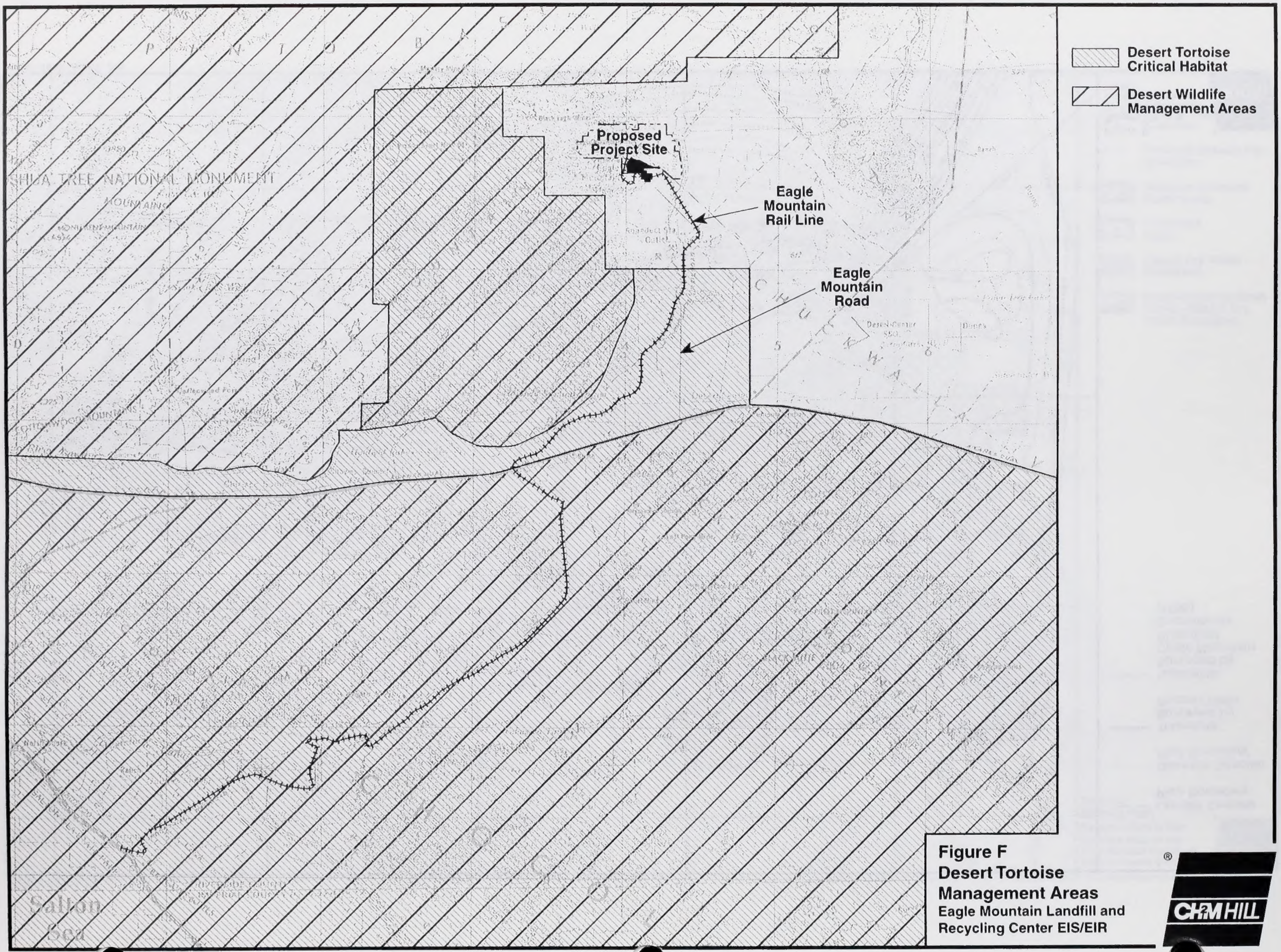

Figure F
Desert Tortoise
Management Areas
Eagle Mountain Landfill and Recycling Center EIS/EIR

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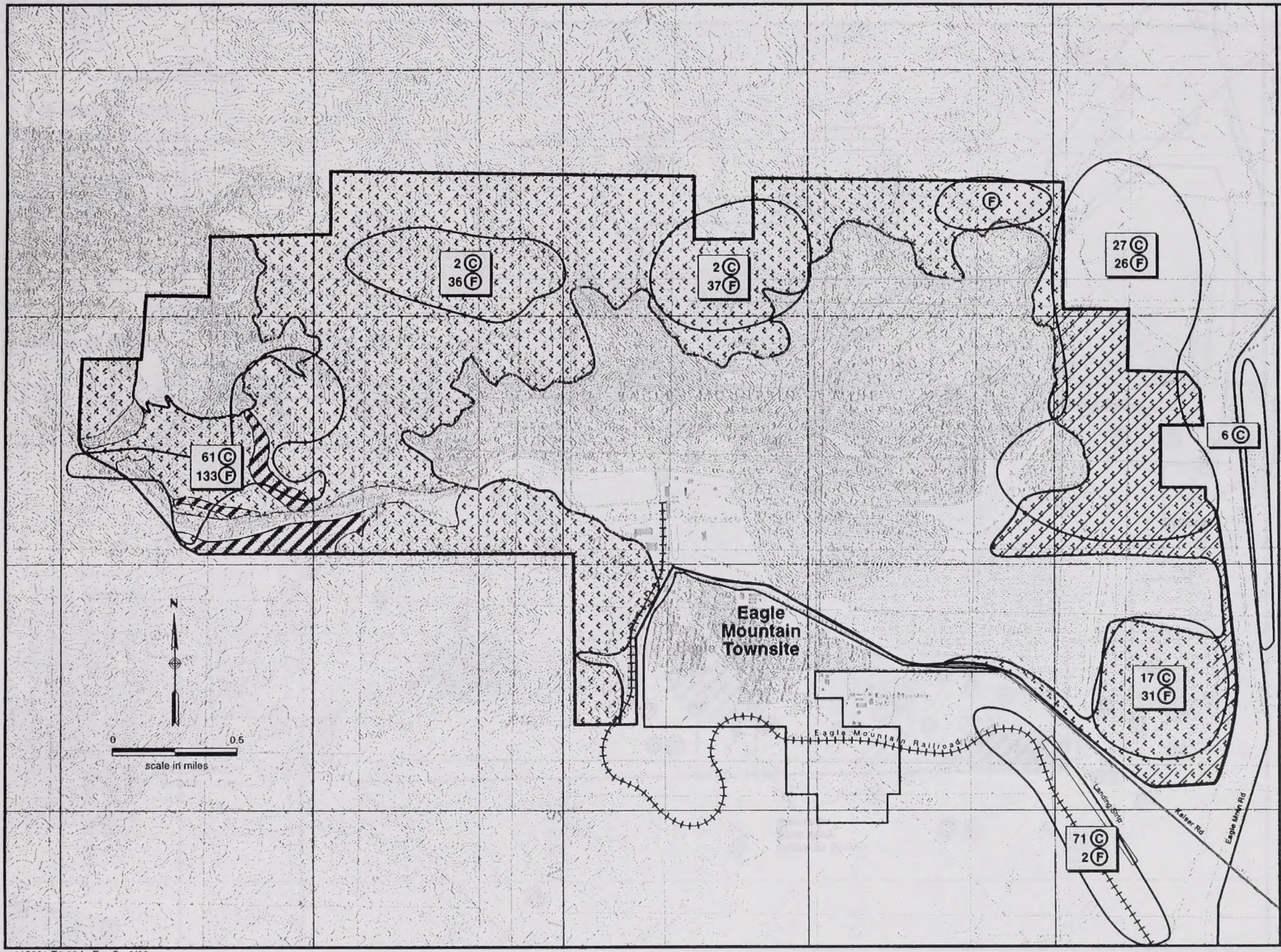

Figure G
Location of Plant Communities and Special Status Plant Species
Eagle Mountain Landfill and Recycling Center EIS/EIR

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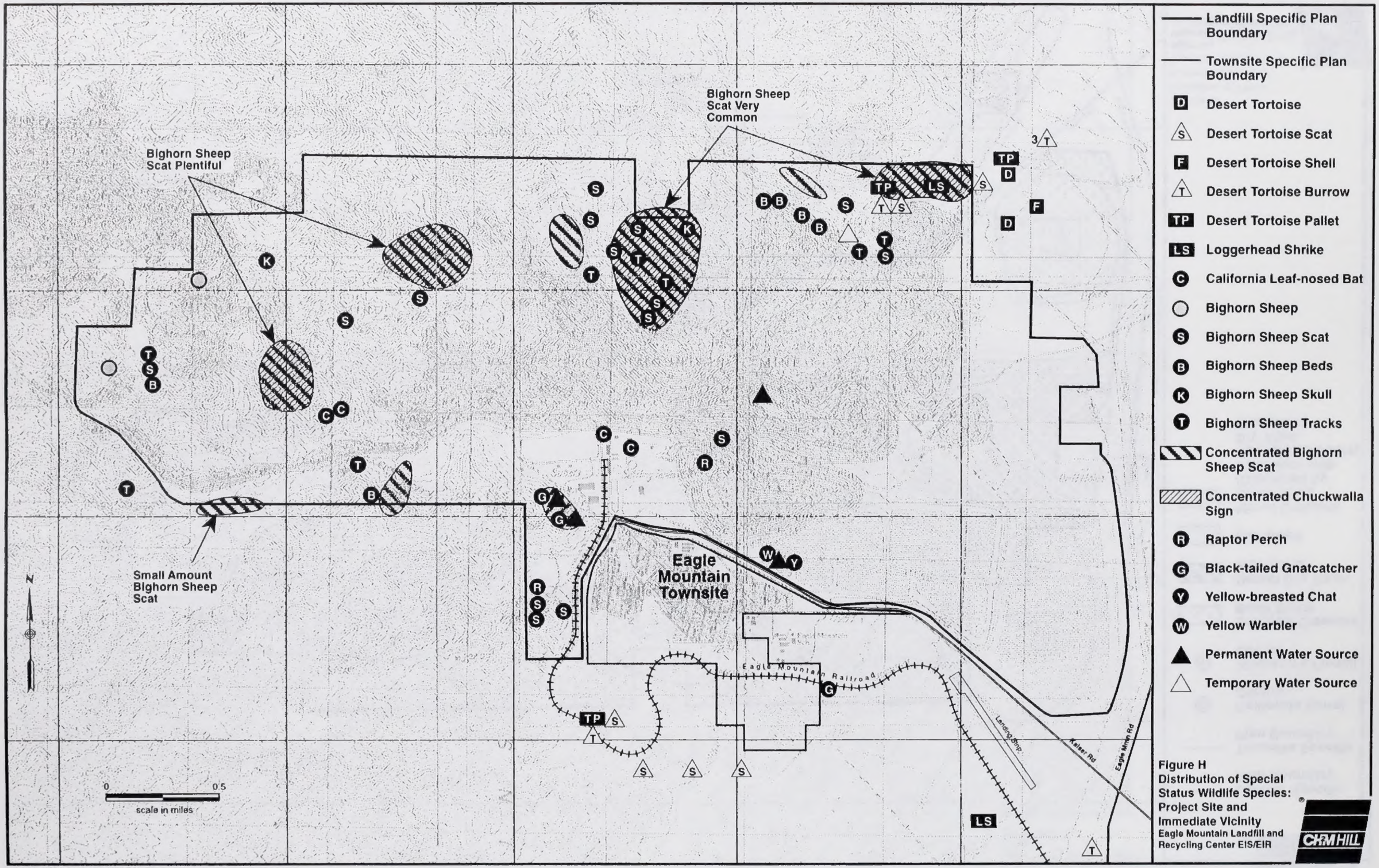

Figure H
Distribution of Special Status Wildlife Species: Project Site and Immediate Vicinity
Eagle Mountain Landfill and Recycling Center EIS/EIR

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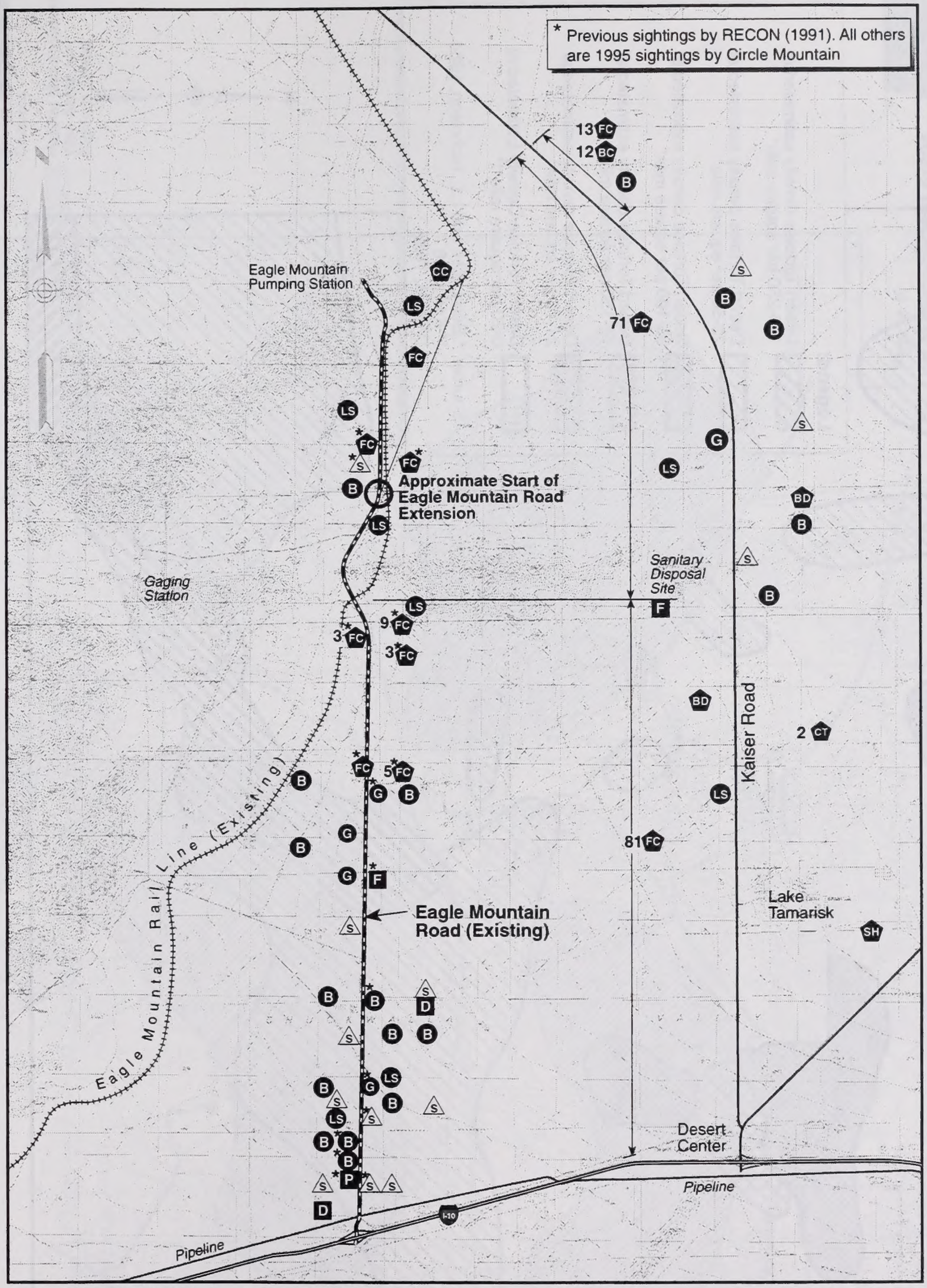

D	Desert Tortoise	CC	Common Chuckwalla
B	Desert Tortoise Burrow	BD	Badger Dig
S	Desert Tortoise Scat	SH	Sharp-Shinned Hawk
F	Desert Tortoise Shell	BC	California Barrel Cactus
P	Desert Tortoise Pallet	FC	Alverson's Foxtail Cactus
G	Black-Tailed Gnatcatcher	CT	Crucifixion Thorn
LS	Loggerhead Shrike		

0 1 2 3 4
approximate scale in thousands of feet

Figure I
Biological Resources of Special Concern on Eagle Mountain Road, Kaiser Road and Spur Location
Eagle Mountain Landfill and Recycling Center EIS/EIR

CH2M HILL

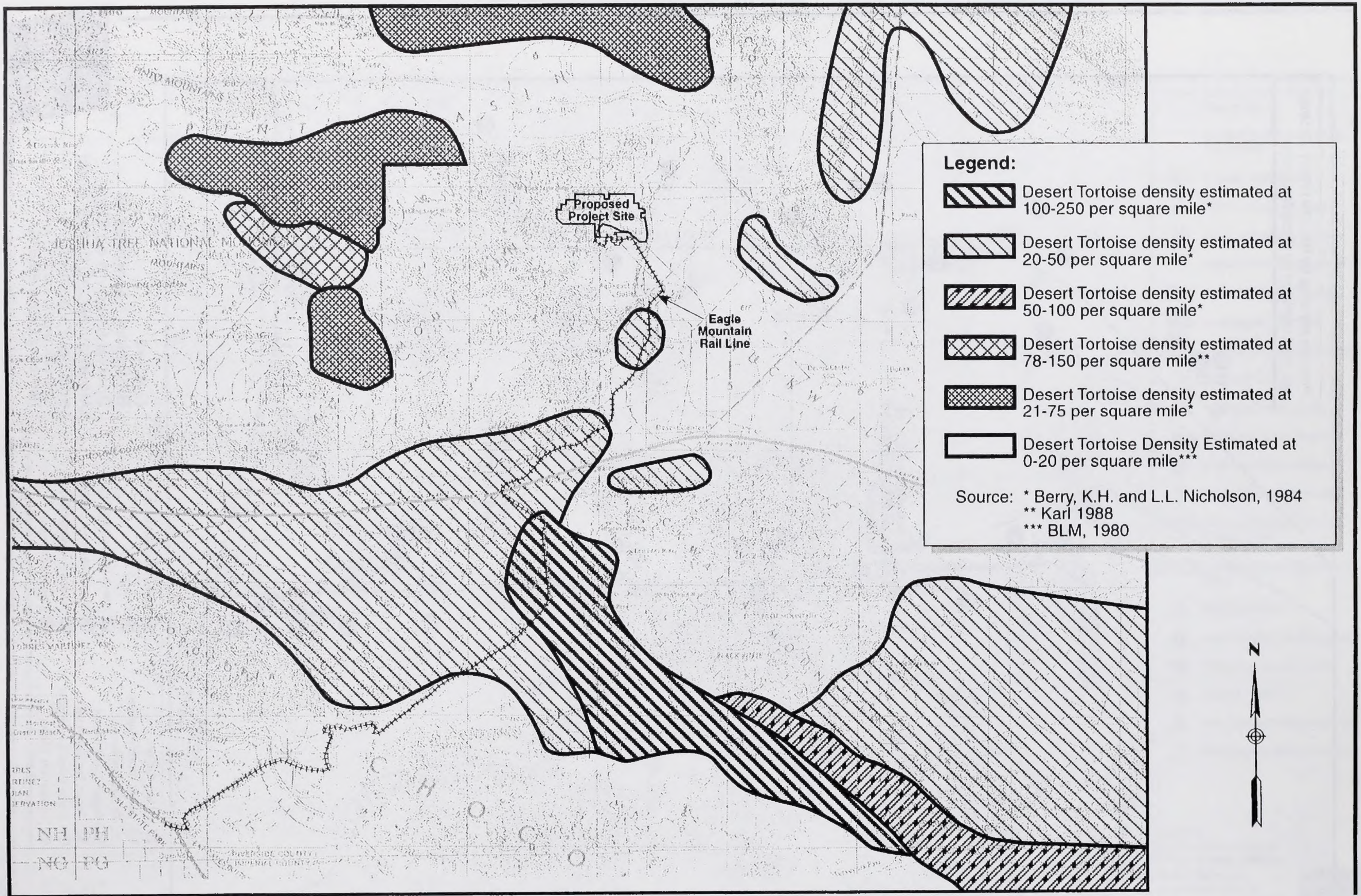

Figure J
General Distribution of Desert Tortoise: South of I-10 to Project Site
Eagle Mountain Landfill and Recycling Center EIS/EIR

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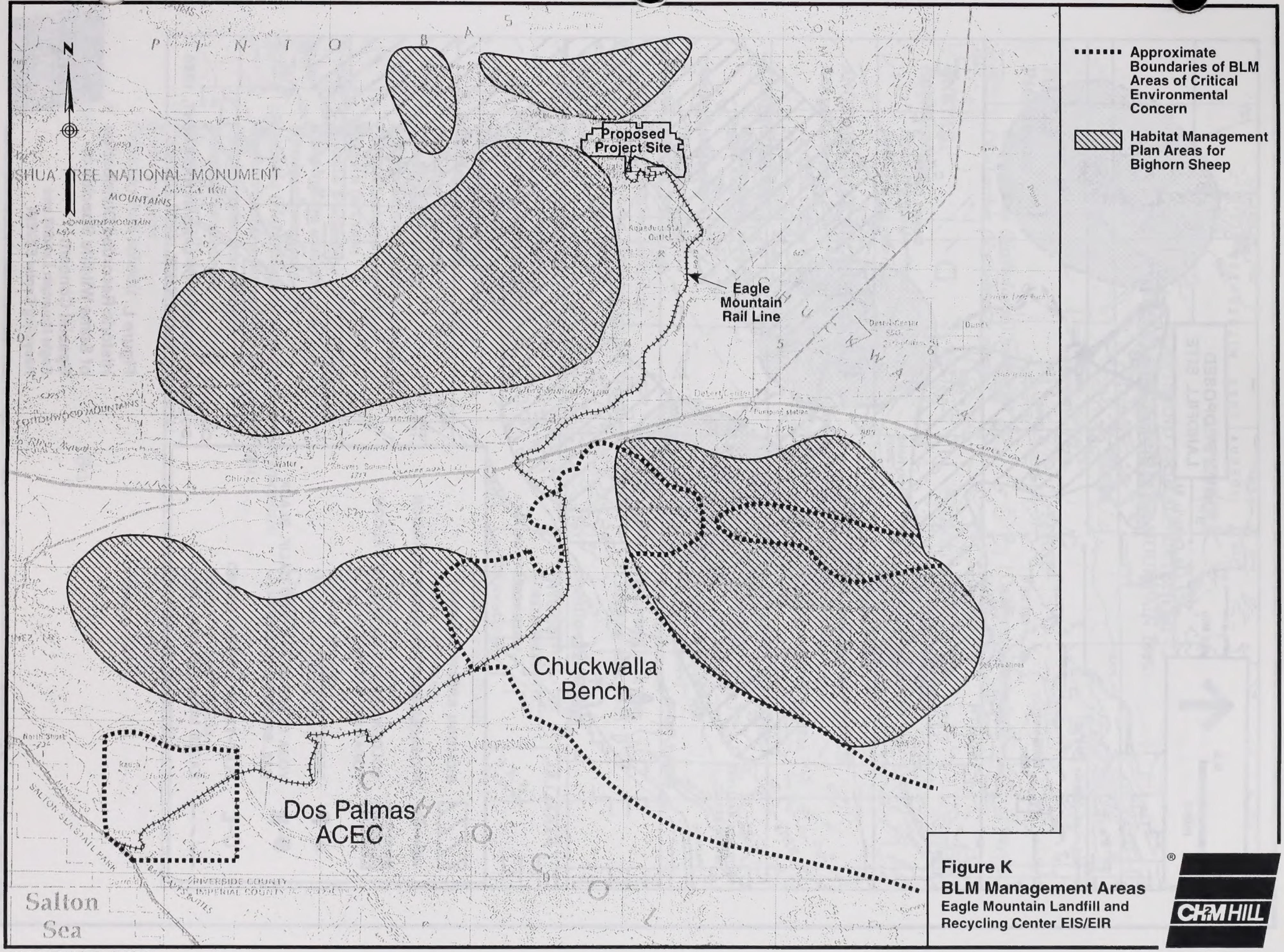

Figure K
BLM Management Areas
Eagle Mountain Landfill and Recycling Center EIS/EIR

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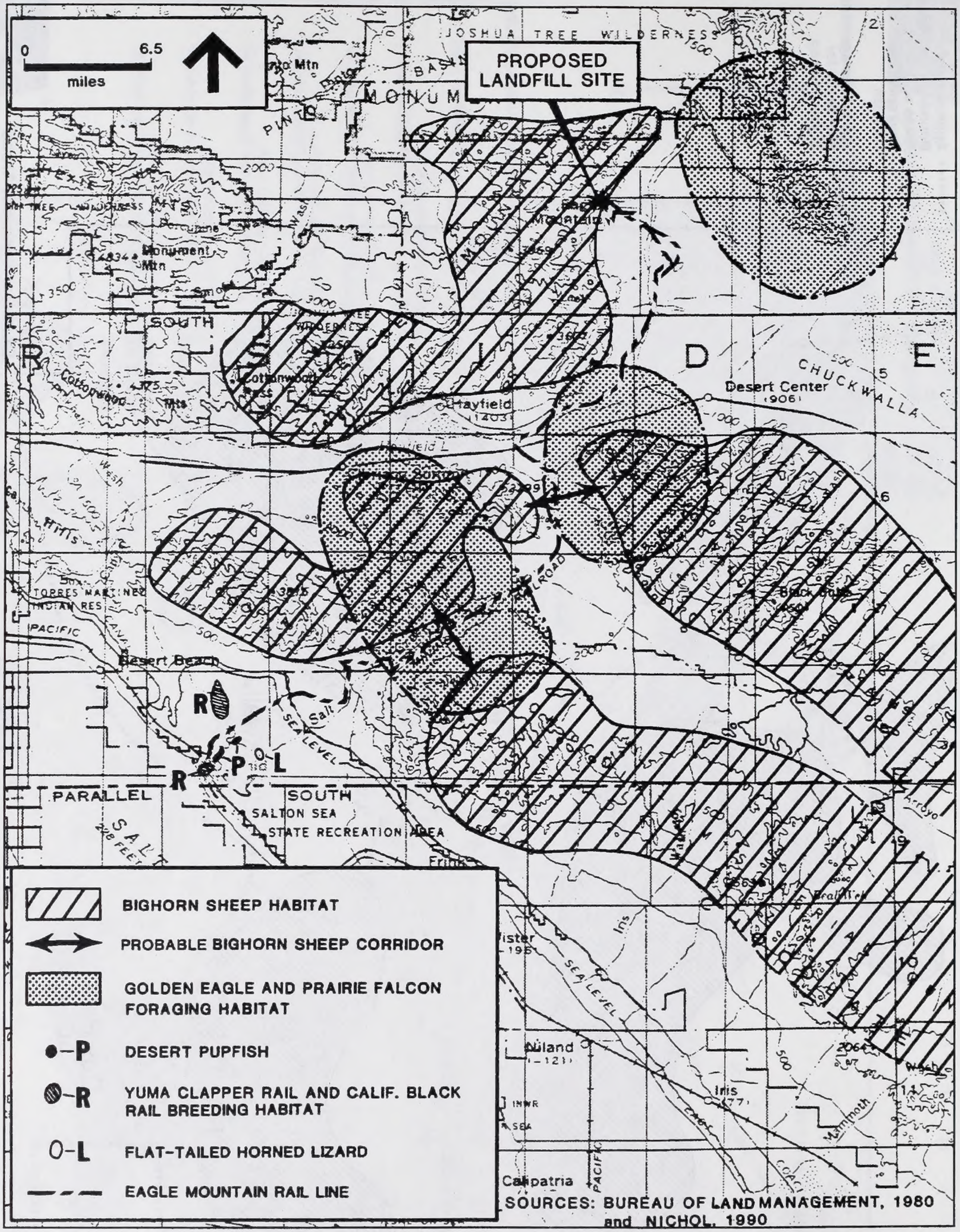

Figure L
Historic Recorded Distribution of Some Wildlife Species of Special Concern
Eagle Mountain Landfill and Recycling Center EIS/EIR

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APPENDIX B

PLANTS AND ANIMALS DETECTED (RECON 1989, 1990; CIRCLE MOUNTAIN 1995)

Plants

FILICAE	FERNS
Pteridaceae	**Ferns**
Cheilanthes (Notholaena) newberryi	California cottonfern
Cheilanthes (Notholaena) parryi	Parry cloakfern
GNETAE	GNETAE
Ephedraceae	**Ephedra family**
Ephedra californica	California joint-fir
Ephedra nevadensis	Nevada joint-fir
ANGIOSPERMAE: DICOTYLEDONES	DICOT FLOWERING PLANTS
Acanthaceae	**Acanthus family**
Justicia californica	Beloperone, chuparosa
Amaranthaceae	**Amaranth Family**
Tidestromia oblongifolia	Honeysweet
Asclepiadaceae	**Milkweed family**
Asclepias albicans	Wax milkweed
Asclepias subulata	Rush milkweed
Sarcostemma hirtellum	Rambling milkvine
Sarcostemma cyanchoides ssp. *hartwegii*	Climbing milkweed
Asteraceae	**Sunflower family**
Ambrosia dumosa	Burrobush
Baccharis emoryi	Emory baccharis
Baccharis sarothroides	Baccharis
Bebbia juncea	Sweetbush
Brickellia desertorum	Desert brickellbush
Brickellia incana	Wooly brickellia
Calycoseris parryi	Yellow tack-stem
Chaenactis fremontii	Fremont's pincushion
Chrysothamnus paniculatus	Wash rabbitbrush
Chrysothamnus teretifolius	Green rabbitbrush
Encelia farinosa	Brittlebush
Encelia fructescens	Rayless encelia
Eriophyllum wallacei	Wallace's woolly daisy
Hymenoclea salsola	Cheesebush
Isocoma (Haplopappus) acradenius ssp. *eremophila*	Goldenbush
Machaeranthera pinnatifida var. *gooddingii* *(Haplopappus gooddingii)*	Spiny goldenbush
Malacothrix glabrata	Glabrous malacothrix
Monoptilòn bellioides	Gray desert star
Palafoxia arida var. *arida (P. linearis)*	Desert Spanish-needle
Pectis papposa	Chinch weed
Peucephyllum schottii	Pigmy-cedar

Pleurocornis pluriseta	Arrow leaf
Pluchea sericea	Arrowweed
Porophyllum gracile	Odora
Psathyrotes ramosissima	Velvet rosettes
Rafinesquia neomexicana	Desert chicory
Stephanomeria exigua	Annual mitra
Stephanomeria pauciflora	Desert milk aster
Trixis californica	California trixis
Xylorhiza (Machaeranthera) tortifolia	Desert aster
Bignoniaceae	**Bigonia family**
Chilopsis linearis	Desert willow
Boraginaceae	**Borage family**
Amsinckia tessellata	Fiddleneck
Cryptantha sp.	Forget-me-not
Cryptantha angustifolia	Narrow-leaved forget-me-not
Cryptantha c.f. *barbigera*	Fuzzy forget-me-not
Cryptantha micrantha	Forget-me-not
Cryptantha nevadensis	Nevada forget-me-not
Pectocarya recurvata	Curved combseed
Tiquilia plicata	Plicate coldenia
Tiquilia palmeri	Palmer's tiquilia
Brassicaceae	**Mustard family**
**Brassica tourneforti*	Wild turnip
**Descurainia pinnata*	Tansy
Lepidium fremontii	Bush peppergrass
Lepidium lasiocarpum	Sand peppergrass
**Sisymbrium orientale*	Sisymbrium
Streptanthella longirostris	Streptanthella
Buxaceae	**Jojoba family**
Simmondsia chinensis	Jojoba
Cactaceae	**Cactus family**
Echinocactus polycephalus	Cottontop cactus
Echinocereus engelmannii	Hedgehog cactus
Escobaria vivipara var. *alversonii*	Foxtail cactus
Ferocactus cylindricus (acanthodes)	Barrel cactus
Mammillaria sp.	Nipple cactus
Mammillaria milleri (M. microcarpa)	Graham nipple cactus
Mammillaria tetrancistra	Yaqui mammillaria
Opuntia acanthocarpa	Cholla
Opuntia basilaris	Beavertail cactus
Opuntia echinocarpa	Silver cholla
Opuntia ramosissima	Pencil cholla
Opuntia wigginsii (=? *O. ramosissima X O. echinocarpa)*	Wiggin's cholla
Campanulaceae	**Bellflower family**
Nemacladus sp.	Nemacladus
Capparaceae	**Caper family**
Isomeris arborea	Bladderpod

Chenopodiaceae	**Goosefoot family**
Allenrolfea occidentalis	Iodine bush
Atriplex canescens	Four-winged saltbush
Atriplex elegans	Wheelscale
Atriplex polycarpa	Allscale
**Salsola tragus (iberica)*	Russian thistle
Suaeda moquinii (S. torreyana)	Torrey's sea-blight
Cucurbitaceae	**Gourd family**
Cucurbita palmata	Coyote gourd
Euphorbiaceae	**Spurge family**
Brabdegea bigelovii	Brandegea
Chamaesyce sp.	Prostrate spurge
Chamaesyce (Euphorbia) micromera	Sonoran sandmat
Chamaesyce (Euphorbia) polycarpa	Small seeded sandmat
Ditaxis lanceolata	Ditaxis
Ditaxis neomexicana	Common ditaxis
Ditaxis serrata	Serrate ditaxis
Stillingia paucidentata	Stillingia
Tetracoccus hallii	Tetracoccus
Fabaceae	**Pea family**
Acacia greggii	Catclaw
Cercidium floridum	Palo verde
Dalea mollissima	Indigo bush
Lotus strigosus (Lotus tomentellus)	Interior lotus
Lupinus sp.	Lupine
Lupinus arizonicus	Arizonia lupine
Lupinus odoratus	Mojave lupine
Marina parryi (Dalea parryi)	Indigo bush
**Melilotus* sp.	Sweetclover
Olneya tesota	Desert ironwood
Prosopis glandulosa var. *torreyana*	Mesquite
Prosopis pubescens	Screw bean mesquite
Psorothamnus emoryi (Dalea emoryi)	Emory dalea
Psorothamnus polydenius	Indigo bush
Psorothamnus schottii	Indigo bush
Psorothamnus spinosus	Smoke tree
Senna (Cassia) armata	Senna
Fouquieriaceae	**Ocotillo family**
Fouquieria splendens	Ocotillo
Geraneaceae	**Geranium family**
**Erodium cicutarium*	Red-stemmed filaree
Hydrophyllaceae	**Water-leaf family**
Nama demissum	Purple mat
Phacelia sp.	Phacelia
Phacelia distans	Common phacelia
Krameriaceae	**Krameria family**
Krameria grayi	White ratany
Krameria erecta (parvifolia)	Pima ratany

Lamiaceae	**Mint family**
Hyptis emoryi	Desert-lavender
Salazaria mexicana	Paper-bag bush
Salvia columbariae	Chia
Salvia greatae	Orocopia sage
Loasaceae	**Stick-leaf family**
Mentzelia sp.	Stick-leaf
Mentzelia involucrata	Blazing star
Petalonyx thurberi ssp. *thurberi*	Sandpaper plant
Malvaceae	**Mallow family**
Eremalche exilis	Trailing mallow
Hibiscus denudatus	Rock hibiscus
Proboscidea althaeifolia	Unicorn-plant
Sphaeralcea sp.	Desert mallow
Sphaeralcea ambigua	Desert mallow
Nyctaginaceae	**Four o'clock family**
Abronia villosa	Desert sand verbena
Mirabilis bigelovii	Desert wishbone plant
Mirabilis multiflora var. *pubescens (M. froebellii)*	Giant four-o'clock
Onagraceae	**Evening-primrose family**
Camissonia boothii	Red primrose
Camissonia boothii ssp. *decorticans*	Shredding evening primrose
Camissonia boothii ssp. *desertorum*	Woody bottle washer
Camissonia brevipes	Yellow cups
Camissonia californica	Camissonia
Camissonia claviformis	Brown-eyed primrose
Camissonia refracta	Narrow-leafed primrose
Oenothera sp.	Evening primrose
Oenothera deltoides	Devil's lantern
Papaveraceae	**Poppy family**
Eschscholzia glyptosperma	Desert gold-poppy
Eschscholzia minutiflora	Little gold-poppy
Eschscholzia parishii	Parish's poppy
Plantaginaceae	**Plantain family**
Plantago sp.	Plantain
Plantago ovata	Plantain
Polemoniaceae	**Phlox family**
Gilia stellata	Dotted-throat gilia
Polygonaceae	**Buckwheat family**
Chorizanthe brevicornu	Brittle spineflower
Chorizanthe spinosa	Mojave spineflower
Chorizanthe rigida	Rigid spineflower
Eriogonum deflexum	Desert skeleton weed
Eriogonum inflatum	Desert trumpet
Eriogonum nudum	Buckwheat
Eriogonum plumatella	Yucca buckwheat

Ranunculaceae	**Crowfoot larkspur**
Delphinium (c.f.) parishii	Desert larkspur
Resedaceae	**Mignonette family**
Oligomeris linifolia	Narrowleaf oligomeris
Rhamnaceae	**Buckthorn family**
Condalia sp.	Condalia
Rosaceae	**Rose family**
Prunus fasciculata	Desert almond
Rubiaceae	**Madder family**
Galium angustifolium	Narrow-leaf bedstraw
Galium stellatum var. *eremicum*	Galium
Thamnosma montana	Turpentine-broom
Scrophulariaceae	**Figwort family**
Mimulus bigelovii	Desert monkey-flower
Mohavea confertiflora	Ghost flower
Solanaceae	**Nightshade family**
Castela emoryi	Crucifixion thorn
Datura wrightii (meteloides)	Jimsonweed
Lycium sp.	Lycium
Lycium andersonii	Anderson's box-thorn
Nicotiana obtusifolia (trigonophylla)	Desert tobacco
Physalis crassifolia var. *crassifolia*	Thick-leaf ground-cherry
Tamaricaceae	**Tamarisk family**
**Tamarix* sp.	Tamarisk
Viscaceae	**Mistletoe family**
Phorodendron californicum	Mesquite mistletoe
Zygophyllaceae	**Caltrop family**
Fagonia laevis	Fagonia
Larrea tridentata	Creosote bush

ANGIOSPERMAE: MONOCOTYLEDONES	MONOCOT FLOWERING PLANTS
Arecaceae	**Palm family**
***Washingtonia filifera*	California fan palm
Juncaceae	**Rush family**
Juncus xiphioides	Rush
Liliaceae	**Lily family**
Agave deserti	Desert agave
Hesperocallis undulata	Desert lily
Nolina bigelovii	Nolina
Yucca schidigera	Mojave yucca
Poaceae	**Grass family**
Aristida adscensionis	Six-weeks three-awn
**Bromus madritensis*	Foxtail chess
**Bromus madritensis* ssp. *rubens*	Red brome
**Cynodon dactylon*	Bermuda grass
Erioneuron pulchellum	Low fluffgrass
**Pennisetum setaceum*	Fountain grass
Phragmites australis	Common reed
Pleuropogon (Hilaria) rigida	Big galleta
**Schismus barbatus*	Abu-mashi
Typhaceae	**Cat-tail family**
Typha sp.	Cat-tail

* - indicates a non-native (introduced) species.
** - introduced to wet areas; not a native population.

c.f. - compares favorably to a given species when the actual species is unknown

Some species may not have been detected because of the seasonal nature of their occurrence. Scientific nomenclature follows Hickman (1993). Older names are included in parentheses. Common names are taken from Hickman (1993), Beauchamp (1986), Jaegar (1969), and Munz (1974).

(Total 175 spp., 91 previously reported by RECON.)

APPENDIX B

PLANTS AND ANIMALS DETECTED (RECON 1989, 1990; CIRCLE MOUNTAIN 1995)

Animals

REPTILIA	REPTILES
Testudinidae	**Land tortoises**
Gopherus agassizii	Desert tortoise
Gekkonidae	**Geckos**
Coleonyx variegatus	Western banded gecko
Iguanidae	**Iguanids**
Dipsosaurus dorsalis	Desert iguana
Sauromalus obesus	Common chuckwalla
Callisaurus draconoides	Zebra-tailed lizard
Uta stansburiana	Side-blotched lizard
Urosaurus graciosus	Long-tailed brush lizard
Phrynosoma sp.	Horned lizard
Teiidae	**Whiptails**
Cnemidophorus tigris	Western whiptail
Colubridae	**Colubrids**
Coluber constrictor	Racer
Viperidae	**Vipers**
Crotalus cerastes	Sidewinder
AVES	BIRDS
Cathartidae	**Vultures**
Cathartes aura	Turkey vulture
Accipitridae	**Hawks, eagles, and harriers**
Circus cyaneus	Northern harrier
Accipiter striatus	Sharp-shinned hawk
Buteo jamaicensis	Red-tailed hawk
Falconidae	**Falcons**
Falco sparverius	American kestrel
Phasianidae	**Grouse and quail**
Alectoris chukar	Chukar
Callipepla gambelii	Gambel's quail
Callipepla californica	California quail(?)
Charadriidae	**Plovers**
Charadrius vociferus	Killdeer

Recurvirostridae	**Stilts and avocets**
Himantopus mexicanus	Black-necked stilt
Columbidae	**Pigeons and doves**
Columba livia	Rock dove
Zenaida macroura	Mourning dove
Cuculidae	**Cuckoos**
Geococcyx californianus	Greater roadrunner
Strigidae	**Typical owls**
Bubo virginianus	Great horned owl
Camprimulgidae	**Nightjars**
Chordeiles acutipennis	Lesser nighthawk
Phalaenoptilus nuttallii	Common poorwill
Apodidae	**Swifts**
Aeronautes saxatalis	White-throated swift
Trochilidae	**Hummingbirds**
Calypte anna	Anna's hummingbird
Calypte costae	Costa's hummingbird
Picidae	**Woodpeckers**
Picoides scalaris	Ladder-backed woodpecker
Colaptes auratus	Northern flicker
Tyrannidae	**Tyrant flycatchers**
Sayornis nigricans	Black phoebe
Sayornis saya	Say's phoebe
Myiarchus cinerascens	Ash-throated flycatcher
Alaudidae	**Larks**
Eremophila alpestris	Horned lark
Hirundinidae	**Swallows**
Tachycineta thalassina	Violet-green swallow
Corvidae	**Crows and jays**
Corvus corax	Common raven
Remizidae	**Verdins**
Auriparus flavipes	Verdin
Troglodytidae	**Wrens**
Campylorhynchus brunneicapillus	Cactus wren
Salpinctes obsoletus	Rock wren
Catherpes mexicanus	Canyon wren

Muscicapidae	**Thrushes and allies**
Regulus calendula	Ruby-crowned kinglet
Polioptila caerula	Blue-gray gnatcatcher
Polioptila melanura	Black-tailed gnatcatcher
Sialia mexicana	Western bluebird
Turdus migratorius	American robin
Mimidae	**Mockingbirds and thrashers**
Oreoscoptes montanus	Sage thrasher
Toxostoma sp.	Thrasher sp.
Tosxostoma lecontei	Le Conte's thrasher
Ptilogonatidae	**Silky flycatchers**
Phainopepla nitens	Phainopepla
Laniidae	**Shrikes**
Lanius ludovicianus	Loggerhead shrike
Sturnidae	**Starlings**
Sturnus vulgaris	European starling
Emberizidae	**Sparrows, warblers, and tanagers**
Dendroica petechia	Yellow warbler
Dendroica coronata	Yellow-rumped warbler
Amphispiza bilineata	Black-throated sparrow
Amphispiza belli	Sage sparrow
Zonotrichia leucophrys	White-crowned sparrow
Junco hyemalis	Dark-eyed junco
Sturnella neglecta	Western meadowlark
Euphagus cyanocephalus	Brewer's blackbird
Fringillidae	**Finches**
Carpodacus mexicanus	House finch
Carduelis psaltria	Lesser goldfinch
Passeridae	**Weavers**
Passer domesticus	House sparrow
MAMMALIA	MAMMALS
Phyllostomatidae	**Leaf-nosed bats**
Macrotis californicus	California leaf-nosed bat
Vespertilionidae	**Evening bats**
Pipistrellus hesperus	Western pipistrelle
Leporidae	**Hares and rabbits**
Lepus californicus	Black-tailed hare
Sylvilagus audubonii	Audubon cottontail

Sciuridae	**Squirrels**
Ammospermophilus leucurus	Antelope ground squirrel
Citellus tereticaudus	Round-tailed ground squirrel
Geomyidae	**Pocket gophers**
Thomomys bottae	Botta pocket gopher
Heteromyidae	**Pocket mice**
Perognathus penicillatus	Desert pocket mouse
Dipodomys sp.	Kangaroo rat
Dipodomys merriami	Merriam kangaroo rat
Dipodomys deserti	Desert kangaroo rat
Cricetidae	**Rats and mice**
Peromyscus crinitus	Canyon mouse
Onychomys torridus	Southern grasshopper mouse
Neotoma lepida	Desert wood rat
Canidae	**Foxes, wolves and coyotes**
Canis latrans	Coyote
Vulpes macrotis	Kit fox
Urocyon cinereoargenteus	Gray fox
Procyonidae	**Raccoons**
Bassariscus astutus	Ringtail
Procyon lotor	Raccoon
Mustelidae	**Weasels and skunks**
Taxidea taxus	Badger
Mephitis mephitis	Striped skunk
Felidae	**Cats**
Lynx rufus	Bobcat
Cervidae	**Elks, moose, caribou, and deer**
Odocoileus hemionus	Mule deer
Bovidae	**Sheep and goats**
Ovis canadensis nelsoni	Nelson's bighorn sheep

Nomenclature follows Stebbins, A Field Guide to Western Reptiles and Amphibians, the American Ornithologists' Union, Checklist of North American Birds, sixth edition, and Ingles, Mammals of the Pacific States.
(10 reptiles, 7 previously reported by RECON; 53 birds, 41 previously reported by RECON; 22 mammals, 20 previously reported by RECON)

APPENDIX C

Chapter 3 lists those special-status elements that are known or expected to occur in the Project area and may therefore be impacted. The following, additional species (a) are absent from the Project area, (b) have been reported from the vicinity of the site (e.g., Salton Sea) but do not occur on-site, (c) were considered in previous environmental documentation but do not occur in the area (e.g., Santa Ana woolly-star, which is restricted to the Santa Ana River and its tributaries), and/or (d) may be marginally but not significantly impacted.

Special-status plant species and communities considered absent.

Desert Fan Palm Oasis Woodland
Status: Federal None/ State Community of Highest Inventory Priority
Records of Likelihood of Occurrence: The nearest record for this community is more than 8.1 km (five miles) distant from the Project areas.

Mecca-aster *(Xylorhiza cognata)*
Status: Federal Category 2 Candidate/ State None/ CNPS List 1B, RED = 2-2-2
Records of Likelihood of Occurrence: This plant is known only from the Mecca Hills (≈ 21 km west) and Indio Hills (≈ 57 km west), between 20 and 240 m elevation.

Orcutt's Aster *(Xylorhiza orcuttii)*
Status: Federal Category 2 Candidate/ State None/ CNPS List 1B, RED = 2-2-2
Records of Likelihood of Occurrence: This plant was not observed by either RECON or CMBC, although it should have been detectable during surveys. It is associated with gypsum soils (Munz 1974), none of which are found within the Project areas. In addition, the species distribution lies to the south of the Project areas (Skinner and Pavlik 1994).

Santa Ana Woolly-star *(Eriastrum densifolium* ssp. *sanctorum)*
Status: Federal Endangered/ California Endangered/ CNPS List 1B, RED = 3-3-3
Records of Likelihood of Occurrence: This species is found only in the Santa Ana River drainage. Current known locations of the plant are part of one extended but fragmented population from Redlands, east to the mouth of Santa Ana Canyon in San Bernardino County (Skinner and Pavlik 1994, RECON 1992a).

Slender-horned Spineflower *(Dodecahema [Centrostegia] leptoceras)*
Status: Federal Endangered/ California Endangered/ CNPS List 1B, RED = 3-3-3
Records of Likelihood of Occurrence: This plant is associated with chaparral and coastal sage scrub. It is known only from five locations in the foothills and valleys west of the Transverse Ranges in San Bernardino and Riverside Counties (Skinner and Pavlik 1994, RECON 1992a). The Project is outside the species known range, and no suitable habitat is present.

Special-status plants that may occur but not be significantly impacted.

Utah Vine Milkweed *(Cynanchum utahense)*
Status: Federal None/ State None/ CNPS List 4, RED = 1-1-1
Life History: Hickman (1993) states that this perennial plant is found below 1,000 m in the Mojave Desert in California, in dry, sandy, or gravelly areas. Munz (1974) reports that this plant is found in both the Sonoran and Mojave Desert in creosote bush scrub. It blooms from April to June.

Records and Likelihood of Occurrence: Utah vine milkweed was not detected in surveys by RECON or CMBC. Given these results, it is considered to have a low likelihood of occurrence throughout the Project areas.

Spearleaf *(Matelea parvifolia)*

Status: Federal None/ State None/ CNPS List 2, RED = 3-1-1

Life History: Spearleaf, or talayote, is perennial shrub with twining stems and greenish or purple flowers, found at dry, rocky locations between 700 and 1,000 m in creosote bush scrub (Hickman 1993). Munz (1974) cites locations of the plant at Corn Springs, Cottonwood Springs, and Yaqui Well. It can reach heights up to 0.5 m (Hickman 1993). It is considered a rare plant, with widely scattered populations (Hickman 1993, Skinner and Pavlik 1994, Munz 1974).

Records and Likelihood of Occurrence: This species was not detected during RECON's or CMBC surveys of the Project areas. The elevational range for the species is higher than that of the access roads or rail line, but the plant could occur at the highest parts of the landfill site. Given the inherent rarity of the species, though appropriate habitat is present, the species is considered to have a low likelihood of occurrence in areas above 700 m elevation.

Mesquite Neststraw *(Stylocine sonorensis)*

Status: Federal None/ State None/ CNPS List 2, RED = 3-3-1

Life History: This annual plant of the aster family is known from only one occurrence in California, although it also occurs in southeast Arizona and northeast Sonora, Mexico (Hickman 1993). It is found in open, sandy drainages at around 400 m in elevation. This plant blooms in April (Skinner and Pavlik 1994).

Records and Likelihood of Occurrence: The single California record for this plant is from Hayfields Dry Lake in 1930. This lake is located about 0.8 to 6.5 km (one-half to four miles) west of the rail line's intersection with I-10. The population may have been extirpated by development (Skinner and Pavlik 1994), although the Data Base considers it extant (California Department of Fish and Game 1994d). Thus the plant is considered to have a low likelihood of occurrence at the landfill site, near the access roads, and near the rail line.

Ribbed Cryptantha *(Cryptantha costata)*

Status: Federal None/ State None/ CNPS List 4, RED = 1-1-2

Life History: This annual plant is found in sandy soils, in creosote bush scrub, at elevations below 500 m, in the Mojave and Sonoran Deserts. It ranges in height from 10 to 20 cm (Hickman 1993). It blooms from February to May (Skinner and Pavlik 1994).

Records and Likelihood of Occurrence: This plant was not observed by RECON or CMBC during surveys of the Project areas. Based on its field survey results, RECON concluded that the likelihood that large populations of the plant are present in the Project areas is low. CMBC concurs with this assessment, but gives the plant a moderate likelihood of occurrence, since appropriate habitat is present and the species could occur off survey routes.

Winged Cryptantha *(Cryptantha holoptera)*

Status: Federal None/ State None/ CNPS List 4, RED = 1-1-2

Life History: This annual herb of the borage family can reach 50 cm height, and is found in the eastern Mojave and Sonoran Deserts, in sandy to rocky soils, at elevations of 100 to 1,200 m (Hickman 1993). Munz (1974) states that the plant has a very scattered distribution.

Records and Likelihood of Occurrence: This species was not detected in surveys by RECON or by CMBC. Based on these results, CMBC concurs with RECON's conclusion that there is a low likelihood that large populations of the species may occur in the Project areas. As with the other special-status species of *Cryptantha*, appropriate habitat is present and there is a moderate likelihood that the species may occur in unsurveyed areas.

Munz's Cholla *(Opuntia munzii)*

Status: Federal Category 2 Candidate Species/ State None/ CNPS List 1B, RED = 3-1-3

Life History: This rare cactus is considered to be a probable hybrid between *Opuntia bigelovii* and *O. echinocarpa*. It is found in gravelly or sandy soils, on canyon walls or in washes, between 150 and 600 m, in the Chocolate and Chuckwalla Mountains, in Riverside and Imperial Counties (Hickman 1993). The Bureau's draft management plan for the Chuckwalla Bench ACEC (USDI Bureau of Land Management undated) reports that the species is found only on alluvial fans between the Chuckwalla and Chocolate Mountains, and south into the Arroyo Seco drainage. This area is east of the rail line. The CNPS Inventory (Skinner and Pavlik 1994) states that this plant is known from fewer than 10 occurrences in the Chocolate Mountains.

Records and Likelihood of Occurrence: It was not found during surveys by RECON or by CMBC, and should have been easily detectable if present. Munz's cholla is therefore considered to have a low likelihood of occurrence on the rail line, and is considered absent from other parts of the Project area, since these areas are outside the plant's known range.

Salton Milkvetch *(Astragalus crotalariae)*

Status: Federal None/ State None/ CNPS List 4, RED = 1-1-3

Life History: This perennial plant is found in the Sonoran Desert, at elevations between 60 m below sea level to 250 m above sea level (Hickman 1993). It is most often found on sandy flats or fans in creosote bush scrub, and flowers from January to April (Munz 1974). The CNPS Inventory (Skinner and Pavlik 1994) indicates that it is found on sandy or gravelly substrates in Imperial, Riverside, and San Diego Counties within California. In the local area it is restricted to dry alkaline areas where selenium is present in the soil (USDI Bureau of Land Management 1982).

Records and Likelihood of Occurrence: Elevations on most parts of the access roads and at the landfill site are too high for the species, and it is considered absent from those locations. It has a low likelihood of occurrence below 250 m elevation near Kaiser Road. The species has been reported from the Salt Creek Desert Pupfish/Rail Habitat ACEC (USDI Bureau of Land Management 1982), and the likelihood of occurrence along the rail line is considered moderate.

Sand-flat Locoweed *(Astragalus insularis* var. *harwoodii)*

Status: Federal None/ State None/ CNPS List 2, RED = 2-2-1

Life History: Sand-flat locoweed or Harwood's milkvetch is an annual plant found from 0 to 300 m elevation, in sandy or gravelly areas in the Sonoran Desert in California (Hickman 1993). The CNPS Inventory (Skinner and Pavlik 1994) indicates that the plant is found in desert dune habitats.

Records and Likelihood of Occurrence: This plant was not detected in surveys by RECON or CMBC. Elevations at the landfill site and on most parts of the access roads are higher than typical for the species. No dune habitat is present within the Project area. Therefore, the species is considered to have a low likelihood of occurrence near access roads or the rail line, and to be absent from the landfill site.

Borrego Milkvetch *(Astragalus lentiginosus* var. *borreganus)*

Status: Federal None/ State None/ CNPS List 4, RED = 1-1-1

Life History: This annual plant (occasionally perennial) is found in sand substrates in the Sonoran Desert between 0 and 250 m elevation (Hickman 1993). Munz (1974) states that it is found in dunes and sandy valleys in creosote bush scrub.

Records and Likelihood of Occurrence: The species was not detected in surveys by RECON or CMBC. Since elevations at the landfill site and access roads are higher than 250 m in most areas, the species is considered absent from these locations. It is considered to have a moderate likelihood of occurrence along Kaiser Road at elevations below 250 m, and in the vicinity of the rail line.

Cove's Senna *(Senna covesii)*
Status: Federal None/ State None/ CNPS List 2, RED = 2-2-1
Life History: This perennial plant grows in the Sonoran Desert in California, usually in sandy, dry washes or on slopes between 500 and 600 m elevation (Hickman 1993). It blooms from April to June, and grows to heights of 30 to 50 cm (Munz 1974).

Records and Likelihood of Occurrence: This plant was not observed during surveys of the Project areas by RECON or CMBC. Only the highest elevations within the landfill site and along the rail line are within the plant's normal distribution. Thus it is considered absent from the vicinity of access roads, and has a low likelihood of occurrence within the landfill site and along the rail line.

Thurber's Pilostyles *(Pilostyles thurberi)*
Status: Federal Category 3C Candidate Species/ State None/ CNPS List 4, RED = 1-1-1
Life History: This parasitic perennial plant (Family Rafflesiaceae) is found in the Sonoran Desert, in open desert scrub at or below 300 m elevation, on plants of the genus *Psorothamnus*, especially *P. emoryi* (Hickman 1993). Munz (1974) states that the species is found most often in Imperial County, but the CNPS Inventory (Skinner and Pavlik 1994) gives Imperial, Riverside, and San Diego Counties as locations for the plant in California.

Records and Likelihood of Occurrence: Psorothamnus emoryi was found along the rail line by RECON, and several other species of *Psorothamnus* were seen by CMBC on the proposed landfill site and near Eagle Mountain and Kaiser Roads. Elevations at the landfill site are higher than given for the species; most parts of the access roads are also above the elevational range for the plant. Thus the likelihood of occurrence for this species is considered low at the landfill and access roads, and moderate along the rail line.

Las Animas Colubrina *(Colubrina californica)*
Status: Federal Category 3C Candidate Species/ State None/ CNPS List 4, RED = 1-1-2
Life History: This shrub of the Rhamnaceae family is found in creosote bush scrub below 1,000 m in the Sonoran Desert in California (Hickman 1993). It is known from dry canyons in northern Riverside County, from the Eagle Mountains and Chuckwalla Mountains (Munz 1974). RECON reports known historic locations near the Project area.

Records and Likelihood of Occurrence: This shrub was not found during surveys of the Project areas by RECON or by CMBC, although it should have been easily detectable, since it reaches heights of up to 2.5 m. It has been reported as "fairly common" in wash habitats in the Chuckwalla Mountains ACEC. Appropriate habitat is present, and the shrub could occur off survey routes. Therefore it is considered to have a moderate likelihood of occurrence within the landfill, a low likelihood of occurrence near access roads, and a moderate likelihood of occurrence near the rail line.

Parish's Desert-thorn *(Lycium parishii)*
Status: Federal None/ State None/ CNPS List 2, RED = 2-1-1
Life History: Hickman (1993) states that Parish's desert-thorn is found in the Sonoran Desert in California, in canyons and on rocky slopes, below 1,000 m. Munz (1974) gives the high point of the shrub's elevational range as 700 m.

Records and Likelihood of Occurrence: This plant was not recorded in surveys of the area by RECON or CMBC. Since it is a shrub, it would likely have been detected if present along survey routes. Therefore CMBC concurs with RECON's conclusion that there is a low likelihood of occurrence for large populations of this plant in any of the Project areas, although appropriate habitat is present in many locations.

Special-status fish, amphibian, and reptile species considered absent.

Colorado Desert Fringe-toed Lizard *(Uma notata notata)*
Status: Federal Category 2 Candidate/ California Species of Special Concern
Records of Likelihood of Occurrence: Colorado fringe-toed lizards inhabit dunes, dry lakebeds, sandy beaches, riverbanks, desert washes, and sparse desert scrub in areas of Imperial and San Diego Counties south of the Salton Sea (Zeiner et al. 1988). The proposed Project is outside the range for this species.

Banded Gila Monster *(Heloderma suspectum cinctum)*
Status: Federal Category 2 Candidate/ California Species of Special Concern
Records of Likelihood of Occurrence: One individual of this species was reported in 1943 from the Chuckwalla Valley, 40.3 km (25 miles) east of Desert Center (Tinkham 1971). This animal may have been released from captivity. No photographs or specimens are available, and no other reports of the species have been found in the area. The known range of gila monsters in California is limited to isolated locations in the Clark, Piute, and Providence Mountains in eastern San Bernardino County (Jennings and Hayes 1994). The species is considered absent from all parts of the Project area.

Special-status bird species considered absent.

Bald Eagle *(Haliaeetus leucocephalus)*
Status: Federal Threatened/ California Endangered
Records of Likelihood of Occurrence: Bald Eagles are not known to winter on the Salton Sea. They rarely breed in southern California, and are known as migrants and winter residents near other large bodies of water, such as Big Bear Lake, Cachuma Lake, Lake Matthews, Silverwood Lake, San Antonio reservoir, and along the Colorado River (Zeiner et al. 1990a). No habitat suitable for the species is present in the Project areas, and Bald Eagles are considered absent from all three locations.

Mountain Plover *(Charadrius montanus)*
Status: Federal Category 2 Candidate/ California Species of Special Concern
Records of Likelihood of Occurrence: Mountain Plovers prefer shortgrass plains, plowed fields, and sagebrush areas. They are known to winter in these types of habitats in the Imperial Valley (Zeiner et al 1990a). Although transient plovers may occasionally pass through the area, there is no ideal habitat for them within the Project areas, and no impacts are expected.

Elf Owl *(Micranthe whitneyi)*
Status: Federal None/ California Endangered
Records of Likelihood of Occurrence: The Elf Owls is known in California as a rare summer and spring resident of the Colorado River Valley, and an occasional visitor at the oases of Cottonwood and Corn Springs in Riverside County (Zeiner et al. 1990a). Although transient owls may occasionally pass through the area, there is no habitat for them within the Project areas.

Arizona Bell's Vireo *(Vireo bellii arizonae)*
Status: Federal None/ California Endangered
and
Least Bell's Vireo *(Vireo bellii pusillus)*
Status: Federal Endangered/ California Endangered
Records of Likelihood of Occurrence: Arizona and Least Bell's Vireos are summer residents of southern California in willows and other low, dense riparian habitats, with an overstory of tall trees. Arizona Bell's Vireos nest along the Colorado River, from Needles south to Blythe, and on the Amargosa River, near Tecopa. Least Bell's Vireos are found in the lower portions of canyons in San Benito and Monterey Counties, in coastal southern California from Santa Barbara south, and along the western edges of the Mojave and Colorado Deserts in desert riparian habitats. The Project area does not fall within the current range of either species, and they are not expected to be impacted by the proposed project.

Tricolored Blackbird *(Agelaius tricolor)*

Status: Federal Category 2 Candidate/ California Species of Special Concern

Records of Likelihood of Occurrence: This species is a resident of fresh water, emergent wetlands in coastal areas and the Central Valley in California, and inland areas in the northern part of the state. Tricolored Blackbirds do not occur regularly in the desert areas of southern California, except in the vicinity of the Antelope Valley. This species is not migratory through most of its range (Zeiner et al. 1990a). It is considered absent throughout the Project areas.

California Brown Pelican *(Pelecanus occidentalis californicus)*

Status: Federal Endangered/ California Endangered/ Special Animal

Life History: California Brown Pelicans are found primarily on the coast line of California and the Channel Islands. Brown Pelicans are seen at the Salton Sea from July to September. They feed primarily on fish, foraging in estuarine, marine, subtidal, and marine pelagic waters. Other food items include crustaceans, carrion, and young of their own species. These birds rest on isolated rocks, on the water, and occasionally on mud flats, sandy beaches, jetties, and wharfs. Brown Pelicans roost at night in concentrations at traditional locations on islands and the main land. Breeding occurs on Anacapa, Santa Barbara, and Santa Cruz islands, all in the Channel Islands. The species has experienced major declines due to pesticide poisoning. These birds are also vulnerable to disturbance at nesting colonies. Roost sites are also affected by human and domestic animal intrusions. Another source of decline is entanglement of individual birds in monofilament fishing line, which may cause injury or impair the bird's ability to feed itself, leading to starvation (Thelander and Crabtree 1994).

Records and Likelihood of Occurrence: Small numbers of Brown Pelicans visit the Salton Sea and Colorado River reservoirs after they disperse from breeding areas (Thelander and Crabtree 1994). These birds typically leave the area in the fall months. Although Brown Pelicans are found at the Salton Sea, they are not likely to occur along the rail line and there is no suitable habitat for them along the access road or on the proposed landfill. They are thus considered to be absent from all project areas, and are not expected to be impacted.

Special-status bird species that may occur but not be significantly impacted.

White-tailed Kite *(Elanus caeruleus)*

Status: Federal None/ California Special Animal

Life History: This raptor frequents open habitats, especially agricultural areas. It is not usually found in desert habitats, but prefers grasslands, meadows, farmlands, and emergent wetlands. It hunts low, over open areas, preying on voles and other day-time active small mammals, and occasionally birds, insects, reptiles, and amphibians. Large groves of dense-canopied trees are favored for cover and nesting, and kites are known to roost in saltgrass and Bermuda grass in southern California. White-tailed Kites breed from February to October, especially from May to August. Clutch size is typically four to five. Eggs are incubated for 28 days; fledging occurs between 35 and 40 days from hatching. Occasionally two broods are produced by a female in one year. Nest predators include jays and crows, magpies, raccoons, and opossums. Great Horned Owls are predators of both young and adults (Zeiner et al. 1990a).

Records and Likelihood of Occurrence: This species is primarily restricted to coastal areas and the Central Valley in California, although it may occur at isolated wetland or agricultural areas, such as agricultural fields north of Lancaster, and Mojave Narrows in Victorville. This bird is not expected to occur along the access road or landfill sites, since it is not migratory and no suitable habitat is present. There is a low likelihood of occurrence along the southwestern portions of the rail line, where wetlands are present.

Swainson's Hawk *(Buteo swainsoni)*

Status: Federal None/ California Threatened

Life History: During the winter in southern California, typical habitat for this species is open desert, grassland, or agricultural land with scattered large trees or groves. This hawk typically forages over grassland or agricultural fields, and feeds on mice, ground squirrels, rabbits, large arthropods, reptiles, birds, and amphibians. Nesting habitat is juniper sage flats, riparian areas, and oak savannah located in the Central Valley and northeastern California. Population levels in California are very low, compared to historic levels, and the species is rarely reported in the vicinity of the Project area. This decline has resulted primarily from loss of nesting habitat (Zeiner et al. 1990a).

Records and Likelihood of Occurrence: This species would rarely be expected during migration (fall and spring months), and may occasionally forage but not nest or winter in any of the three areas. The likelihood of occurrence is considered low throughout.

Ferruginous Hawk *(Buteo regalis)*

Status: Federal Category 2 Candidate/ California Species of Special Concern

Life History: This species is an uncommon winter resident or migrant in California. During the winter in southern California, Ferruginous Hawks frequent open habitats including desert scrub. They prey on rabbits, hares, ground squirrels, and mice. Lone trees or utility poles in open areas are preferred for roosting. This species is not known to breed in California, but can be seen from September to mid-April. Predators include Golden Eagles and Great Horned Owls. This raptor may compete with many other mammals and hawks preying on small mammals, and tends to displace Red-tailed and Swainson's Hawks (Zeiner et al. 1990a).

Records and Likelihood of Occurrence: This species is considered to have a moderate likelihood of occurrence in all three parts of the Project area, given the availability of suitable wintering habitat.

Merlin *(Falco columbarius)*

Status: Federal None/ California Species of Special Concern

Life History: Merlins are small falcons found in many habitats including annual grasslands, oak savannahs, woodlands, lakes, wetlands, and coastlines. They are rarely found in heavily wooded areas or open deserts. They are known as a rare winter migrant in the Mojave Desert, and the Project area falls within the winter range for this species. Merlins feed principally on small birds and also on insects and small mammals. They require dense stands of trees near water for cover. Threats to this species include pesticide poisoning (through prey). They compete with other avian predators such as Sharp-shinned Hawks and Cooper's Hawks (Zeiner et al. 1990a).

Records and Likelihood of Occurrence: Appropriate habitat is not present within the Project areas, except along the southwestern portions of the rail line, where wetlands are present near the Salton Sea, and near Lake Tamarisk on Kaiser Road. Therefore, Merlins have a low likelihood of occurrence at the landfill site, and a moderate likelihood of occurrence along the rail line and access roads during the fall and winter months.

Peregrine Falcon *(Falco peregrinus)*

Status: Federal Endangered/ California Endangered

Life History: This species is found in woodland, forest, and coastal habitats during the breeding season, and in riparian areas, and coastal and inland wetlands throughout the year. Canyons and high cliffs with ledges are typical nest sites, although buildings, bridges, and other human made structures with appropriate ledges and available prey are sometimes used. Peregrines breed and feed near water. Peregrine Falcons are predators of birds, often taking prey in flight. They can kill birds as large as a duck. Occasionally these falcons feed on mammals, fish, and insects. The breeding period for this falcon is early March to late August. Predators of falcons include young Golden Eagles, Great Horned Owls, raccoons, foxes, and other mammals. Threats to the species include collecting for falconry, disturbance at nesting cliffs (e.g., rock climbers), and especially pesticide (DDE) poisoning and resulting egg-shell thinning and reduced reproductive success (Zeiner et al. 1990a).

Records and Likelihood of Occurrence: No Peregrines were observed during surveys of the Project area, and little suitable habitat is present. Most of the Project areas are outside the known range for the species (Zeiner et al. 1990a). Some foraging habitat is present in wetland areas near the Salton Sea along the rail line. A Peregrine Falcon was observed on the west-central shore of the Salton Sea in April of 1989 by LaRue. Thus the species is considered to have a moderate likelihood of occurrence along the rail line, and a low likelihood of occurrence in the other Project areas, and would be expected only during migration.

California Black Rail *(Laterallus jamaicensis coturniculus)*
Status: Federal Category 2 Candidate/ California Threatened

Life History: California Black Rails are secretive birds found primarily in tidal salt marshes, but also in freshwater and brackish marshes. Optimal habitat is well-developed, high marsh, characterized by stable water levels and rare flooding. Dense stands of low-growing aquatic plants, such as pickleweed, grow in a mosaic with drier upland areas and patches of open water, which allows cover and plant materials needed for nesting. This bird feeds on insects, crustaceans, other arthropods and seeds of aquatic plants. Information about the life history of this seldom observed bird is limited. Nests are woven of grasses or sedges, in a location completely concealed by vegetation. Clutches range from three to eight eggs, which hatch after an incubation period of 16 to 20 days. Rails are territorial birds and do not flock. Adult rails do not appear to migrate, though juveniles may disperse several kilometers from their breeding areas in autumn or winter. Factors in the decline of this species are the loss and fragmentation of well-developed marshes and emergent wetlands throughout the state, as well as contamination of marsh areas with pollutants toxic to birds and other wildlife, water reclamation projects, and increased predation in more upland habitats from herons, domestic cats, and nonnative red foxes. Water diversions from marsh areas exacerbate the problem of contaminants, since these are more concentrated with reduced flows (e.g., elevated selenium levels in eggs and tissues of Black Rails along the Colorado River have been documented) (Thelander and Crabtree 1994).

Records and Likelihood of Occurrence: RECON's 1991 report cites a Bureau of Reclamation study in 1989, in which Black Rails were observed in the Salt Creek Area north of the rail line (Figure 1.). CMBC concurs with RECON's conclusion that Black Rails are not expected to be present in the immediate vicinity of the rail line, but do occur within 1.6 km (one mile) of the Project area in better developed marsh habitat. The species is absent from the landfill site and access roads, since suitable habitat is lacking.

Yuma Clapper Rail *(Rallus longirostris yumanensis)*
Status: Federal Endangered/ California Threatened

Life History: Yuma Clapper Rails are residents of freshwater marshes along the Colorado River and Salton Sea in California. They require areas of regenerating marsh for foraging and mature stands of cattails and bullrushes for nesting. In the Salton Sea area, Yuma Clapper Rails are most numerous in the densest cattail (*Typha* spp.) stands and do not use bulrush (*Scirpus* spp.) to any significant extent, possibly because bulrush marshes at the Salton Sea are frequently dry (Bennett and Ohmart 1978, cited in Anderson and Ohmart 1985). These birds feed on crayfish, small fishes, beetles, and isopods found near open water. Nests are built on dry hummocks or under dead emergent plants, and at the bases of bulrushes and cattails. Bennett and Ohmart (1978, cited in Anderson and Ohmart 1985) found that crayfish were most abundant in stands of cattails, perhaps contributing to the birds' heavy use of this type of habitat. Clapper rails breed in mid-March through July. Clutch sizes range from six to seven eggs, which are incubated by the female for a period of 23-28 days. Young fledge at the age of 63-70 days. This rail is no longer considered migratory, although the juveniles disperse following the breeding season. Factors that have contributed to this species decline include loss and fragmentation of wetlands, especially on the Colorado River, due primarily to dam building, and diversion of water for agriculture, dredging, and mosquito abatement programs. Water diversions have also contributed to high levels of toxic contaminants, such as selenium (Thelander and Crabtree 1994).

Records and Likelihood of Occurrence: The Natural Diversity Data Base (California Department of Fish and Game 1994d) reports two observations of Yuma Clapper Rail in Salt Creek and at Rancho Dos Palmas. One of these records is located approximately 0.4 km (one-quarter mile) south of the rail line (Figure 1.). RECON's 1991 report states that Yuma Clapper Rails were not observed within 30 m of the rail line, and that they require over 7 hectares of habitat to breed and forage. CMBC agrees with RECON's conclusion that, since the extent of habitat adjacent to the rail line is smaller than that required by Clapper Rails, there is a low likelihood of occurrence for this species along the rail line. No suitable habitat is present near the landfill site or access roads and the species is considered absent from these locations.

Western Snowy Plover *(Charadrius alexandrinus nivosus)*

Status: Federal Category 3C Candidate Species/ California Species of Special Concern

Life History: In California, Western Snowy Plovers winter on sandy ocean and estuarine shorelines, salt ponds, and (rarely) at the Salton Sea. They nest in the same types of areas, and nesting Snowy Plovers are found at Mono Lake, the Salton Sea, and at scattered alkaline lakes in the deserts and Great Basin in California as well. They feed on insects and amphipods in coastal areas, and on brine flies at salt ponds - and alkali lakes. They nest in shallow depressions on sandy substrates, often in the shelter of driftwood, rocks, or dead shrubs. The breeding season for this species is from April to August. Snowy Plovers nest solitarily, rather than in colonies. The size and density of nesting territories apparently depends on predation pressures; where predation rates are low, up to 20 nests per six hectares (15 acres) have been observed, while as few as one nest per six hectares have been found where predation pressures are high. Two to six eggs are laid in a clutch, with an average of three. Incubation lasts for about 24 days. Young are precocial, and capable of following adults to foraging areas within one day, and evading predators at two days. They learn to fly by the age of 29 to 47 days. Important predators that have been recorded during studies of the species at Mono Lake include coyotes, skunks, gulls, and ravens (Zeiner et al. 1990a).

Records and Likelihood of Occurrence: Western Snowy Plovers are not expected to occur at the landfill site, or along access roads, since no suitable habitat is present in these areas. Parts of the rail line, near Ferrum Junction, pass through appropriate habitat, and the species is given a moderate likelihood of occurrence in these areas.

Vaux's Swift *(Chaetura vauxi)*

Status: Federal None/ California Species of Special Concern

Life History: This species is known in southern California from migration only. It is a summer resident of redwood and Douglas fir habitats in northern California. Vaux's Swifts feed exclusively on insects caught in flight. Foraging flights occur over most terrains and habitats. These birds nest in cavities, and roost, often in large flocks, in hollow trees and snags (Zeiner et al. 1990a).

Records and Likelihood of Occurrence: This species does not breed in southern California, but is moderately likely to occur as a migrant in all Project areas.

Gila Woodpecker *(Centurus uropygialis)*

Status: Federal None/ California Endangered

Life History: Gila Woodpeckers were formerly common residents of willow and cottonwood forests along the Colorado River and south from the Salton Sea to Mexico. They may inhabit parks or residential areas with tall trees. These woodpeckers feed on insects taken from under loose tree bark and mistletoe berries found in honey mesquite woodlands and desert washes during the winter months. Gila Woodpeckers have declined due to a number of factors in California; loss of riparian habitat along the Colorado River and elsewhere is undoubtedly the most important. Even where riparian woodlands persist, they are often too small in area (less than 20 hectares) to support these birds. European starlings compete with these woodpeckers for nest sites when they are forced to occupy less than optimal habitat, such as suburban neighborhoods (Thelander and Crabtree 1994).

Records and Likelihood of Occurrence: RECON's report (1991) states that the species is infrequently observed foraging in habitats in the Colorado Desert similar to those found within the Project sites. Peter Woodman (pers. comm., May 1995) reports seeing this bird in a cavity in a telephone pole, approximately 2.4 km (1.5 miles) north of Bradshaw Trail at the north end of the Chocolate Mountains Gunnery Range, approximately 16.1 to 19.4 km (10 to 12 miles) southwest of the junction of Eagle Mountain Road and I-10. Therefore, the species is assigned a moderate likelihood of occurrence along the rail line, and a low likelihood of occurrence in the other two locations, and no breeding would be expected.

Southwestern Willow Flycatcher *(Empidonax traillii extimus)*
Status: Federal Proposed Endangered/ California Endangered
Life History: Willow Flycatchers are summer residents of wet meadow and montane riparian habitats. They may be seen as low elevation migrants throughout California except the north coast, in the spring and fall, especially in riparian habitats. They feed on flying insects, as well as seeds and fruit. Nest parasitism by Brown-Headed Cowbirds, loss and degradation of willow riparian habitats (especially due to cattle grazing), have contributed to the species decline (Zeiner et al. 1990a).

Records and Likelihood of Occurrence: These birds have a low likelihood of occurrence, and would possibly be found in wash areas, near ponds or wetlands during the spring and fall migration periods. No suitable nesting habitat is present, as the Project areas are outside the breeding range for the species.

Purple Martin *(Progne subis)*
Status: Federal None/ California Species of Special Concern
Life History: Purple Martins are summer residents of wooded, low elevation habitats throughout California. These include valley foothill and montane hardwood woodlands, valley foothill and montane hardwood-conifer woodlands, riparian woodlands, closed-cone pine-cypress forest, ponderosa pine, Douglas-fir, and redwood forests. They are occasionally found in desert regions during migration. They may also be found in variety of open habitats, such as fresh water emergent wetlands, meadows, and grasslands. These birds feed on insects, caught on the wing in long, gliding flights. Purple Martins have declined in California due to a loss of riparian habitat, removal of snags (i.e., dead trees), and competition for nest sites with introduced European Starlings and House Sparrows (Zeiner *et al.* 1990).

Records and Likelihood of Occurrence: These birds are expected only as rare migrants in any of the Project areas.

Bendire's Thrasher *(Toxostoma bendirei)*
Status: Federal None/ California Species of Special Concern
Life History: This species is a spring and summer resident and breeder in desert succulent scrub and Joshua tree woodland in the Mojave Desert. Breeding also occurs in the Colorado Desert. Bendire's Thrashers breed from late February to early August. A clutch of three to (rarely) five eggs is laid in a nest located in thorny shrub or cactus. This bird feeds on beetles, caterpillars, and other insects. Factors leading to the decline of Bendire's Thrasher populations include harvesting of desert vegetation, such as Joshua trees and other yuccas, grazing, off-highway vehicle use, and urban development (Zeiner et al. 1990a).

Records and Likelihood of Occurrence: Bendire's Thrashers have a moderate likelihood of occurrence in the landfill site, near access roads, and along the rail line, especially where Joshua tree woodland is present. They have been reported from nearby Cottonwood Springs and other nearby locations (California Department of Fish and Game 1995).

Crissal Thrasher *(Toxostoma crissale)*
Status: Federal None/ California Species of Special Concern
Life History: This species occurs primarily in desert riparian and desert wash habitats, in dense thickets or low trees along the Colorado River. It prefers the most shaded and moist desert habitats and feeds on invertebrates, berries, fruits, seeds, and small lizards. Crissal Thrashers breed from February to June, with a peak from March to April. Clutch sizes range from two to four eggs, and two clutches are often laid per season. Incubation takes about 14 days, and the young fledge at age 11-12 days. Threats to the species include off-highway vehicle activity, loss of habitats to agriculture, and the introduction of tamarisk, an invasive exotic plant that reduces available water and out-competes native vegetation, often establishing almost pure stands (Zeiner et al. 1990a).

Records and Likelihood of Occurrence: Crissal Thrashers have a low likelihood of occurrence on the landfill site, near access roads, and along the rail line, and are most likely to occur in wash habitats.

Virginia Warbler *(Vermivora virginiae)*
Status: Federal None/ California Species of Special Concern
Life History: This species is known from arid, shrubby habitats including mixed conifer, pinyon-juniper, montane chaparral, and perhaps montane riparian in limited areas of the state. In southern California it is found in mountains in the eastern Mojave, including the New York Mountains, and the northeastern San Bernardino Mountains. Virginia Warblers feed on insects and other invertebrates (Zeiner et al. 1990a).

Records and Likelihood of Occurrence: This species would only be expected as a rare migrant in any of the three Project areas.

Special-status mammal species considered absent.

Arizona Myotis *(Myotis lucifugus occultus)*
Status: Federal Category 2 Candidate/ California Species of Special Concern
Life History: The closest populations of this species to the Project site occur along the Colorado River. An isolated population is also known from the San Bernardino Mountains. It is a year-round resident in both locations (Zeiner et al. 1990b).

Records of Likelihood of Occurrence: Arizona myotis is considered absent since its known range does not include the area.

Arizona Cave Myotis *(Myotis velifer brevis)*
Status: Federal Category 2 Candidate/ California Species of Special Concern
Life History: This species occurs in California in the lowlands of the Colorado River and in adjacent mountain ranges. It appears to be present in the state only in summer and fall, and may migrate to hibernacula farther south, probably in Mexico (Zeiner et al. 1990b).

Records of Likelihood of Occurrence: The Project area is outside the species' known range so it is considered absent.

Special-status mammal species that may occur but not be significantly impacted.

Spotted Bat *(Euderma maculatum)*
Status: Federal Category 2 Candidate/ California Species of Special Concern
Life History: Spotted bats are considered to be one of the rarest mammals in North America. While these bats occur in a variety of habitats, ranging from desert to mixed conifer forests, they are solitary, crevice-roosting animals and difficult to detect. They also forage in the late night and early morning hours. They apparently feed primarily on moths and forage over water and along washes. Cliffs are preferred roosting sites (Zeiner et al. 1990b).

Records and Likelihood of Occurrence: This species was not detected during Brown's 1990 surveys of the landfill site. The Project areas fall within the species known range, but the likelihood of occurrence for spotted bats is not known.

Pocketed Free-tailed Bat *(Nyctinomops femorosaccus)*

Status: Federal None/ California Species of Special Concern

Life History: Pocketed free-tailed bats are known in California from Riverside, Imperial, and San Diego Counties. They use pinyon-juniper woodland, desert scrub, desert succulent scrub, desert riparian, desert wash, alkali desert scrub, Joshua tree woodland, and palm oasis habitats. They typically feed high over ponds, streams, or arid desert, locating insect prey by echolocation. Large moths are an important food item. This species roosts in rock crevices, caverns, or buildings, and prefers rocky desert locations with high cliffs or rock outcrops for roosting. Pocketed free-tailed bats bear young in June and July, with a typical litter of one (Zeiner et al. 1990b).

Records and Likelihood of Occurrence: Brown (1990) lists this species as one that could occur at various times within the Project area. Pocketed free-tailed bats were not detected during her 1990 surveys of the landfill site (Brown 1990), but it may be that the species habit of foraging and flying high makes it less likely to be captured or detected than species flying at the level of mist nets. The site is within the species range, but the likelihood of occurrence for this bat is not known.

Yuma Mountain Lion *(Felis concolor browni)*

Status: Federal Category 2 Candidate/ California Species of Special Concern

Life History: Little information is available on the Yuma mountain lion, a subspecies known from records in the lower elevations of the Colorado River Valley. The type specimen was presented by Herbert Brown to the U.S. Biological Survey in 1903 and named by Merriam. This animal was from the desert region of the Colorado River, south of Yuma, Arizona. It was distinguished by having relatively small bulae and small lateral teeth. Some controversy exists over whether this animal is a genetically valid subspecies, rather than a locally adapted population. The Yuma mountain lion was found primarily in dense bottomland vegetation along the river and in adjacent rocky uplands. One record (Halloran 1946 cited in Williams 1986) was from "rough desert terrain" on the Kofa Game Range 80.6 km (50 miles) northeast of Yuma, Arizona. Williams (1986) states that the historic range of the species may have extended to the Imperial Valley to the west and the Amargosa Mountains to the north. Records of this race of lion have all been at or below 360 m (Grinnell 1933, Williams 1986). The area of Riverside and Imperial Counties through which the rail line passes is thought to support only transient lions, rather than a resident population (Weaver 1982). The tiny Coue's white-tailed deer *(Odocoileus virginianus cousei)* may have been the main prey species for this animal in prehistoric times (Williams 1986). Burro deer *(Odocoileus hemionus eremicus)* are likely to be the principal prey in more recent periods. Other prey items may include bighorn sheep, rabbits, hares, various rodents, and calves (Williams 1986).

Records and Likelihood of Occurrence: Range maps for mountain lion in California show no gaps between habitat along the Colorado River and mountainous desert areas to the north and west, including areas along the rail line, access roads, and landfill site (Zeiner et al 1990b). Appropriate prey species (bighorn sheep, burro deer, and mule deer) are present within Project areas, although dense riparian habitat similar to that formerly found throughout the Colorado River Valley is absent. No mountain lion sign was detected during surveys of the Project areas by RECON (RECON 1992a) or CMBC. The information available is not sufficient to determine the likelihood of occurrence for this animal.

APPENDIX D

Data Used in Analysis of Biological Opinions on Desert Tortoise

Table D-1. Harassment and Mortality Take Limits for California.

All California Projects			**Harassment for Only Projects That Occurred**			**Mortality for Only Projects That Occurred**		
Project type	No. Opinions	Project status	Expected	Actual	Exceeded?	Expected	Actual	Exceeded?
Mining	25 opinions 23 projects	19 occurred 6 No Project	187 2 no limit	59 (31.5%)	1 exceeded 1 met	62	**2** (3.2%)	0 exceeded 1 met
Highway	14 opinions 14 projects	10 occurred 4 No Project	79 2 no limit	16 (20%)	0 exceeded 0 met	29	**1** (3.4%)	0 exceeded 0 met
Transmission Lines	16 opinions 15 projects	15 occurred 1 no project	109 1 no limit	227 (208%)	1 exceeded 0 met	36	**7** (19.4%)	0 exceeded 0 met
Tract/Parcel	19 opinions 19 projects	13 Occurred 6 No Project	232 2 no limit	13 (6%)	1 exceeded 0 met	20	0 (0%)	0 exceeded 0 met
Pipeline	22 opinions 22 projects	19 Occurred 3 No Project	565 2 no limit	583 (103%)	2 exceeded 0 met	77	**38** (49%)	1 exceeded 0 met
Programmatic	13 opinions 12 projects	13 occurred 0 no project	76 3 no limit	5 (7%)	0 exceeded 0 met	129	0 (0%)	0 exceeded 0 met
Miscellaneous Military	8 opinions 8 projects	7 occurred 1 no project	94	14 (15%)	0 exceeded 0 met	36	**5** (14%)	0 exceeded 0 met
Landfill	3 opinions 3 projects	2 occurred 1 no project	10	0 (0%)	0 exceeded 0 met	2	0 (0%)	0 exceeded 0 met
Hazardous Materials	3 opinions 3 projects	1 occurred 2 no project	1 no limit	0 (0%)	0 exceeded 0 met	2	0 (0%)	0 exceeded 0 met
Flood Control	1 opinion 2 project	0 occurred 1 no project	N/A	N/A	N/A	N/A	N/A	N/A
Miscellaneous	2 opinions 2 projects	2 occurred 0 no project	10	2 (20%)	1 exceeded 0 met	1	0 (0%)	0 exceeded 0 met
11 project types	126 opinions 123 projects	101 occurred 25 no project	1,362 13 no limit	919 (67%)	6 exceeded 1 met	394	**53** (13%)	1 exceeded 1 met

Table D-2. Harassment and Mortality Take Limits for Nevada.

All Nevada Projects			**Harassment for Only Projects That occurred**			**Mortality for Only Projects That occurred**		
Project type	No. Opinions	Project status	Expected	Actual	Exceeded?	Expected	Actual	Exceeded?
Mining	17 opinions 32 projects	13 occurred 4 no project	287	118 (41%)	1 exceeded 1 met	26	0 (0%)	0 exceeded 0 met
Highway	16 opinions 16 projects	10 occurred 6 no project	224	9 (4%)	0 exceeded 0 met	28	0 (0%)	0 exceeded 0 met
Utility	23 opinions 26 projects	19 occurred 4 no project	322 2 no limit	72 (22%)	1 exceeded 1 met	45	**3** (7%)	0 exceeded 0 met
Tract/Parcel	24 opinions 38 projects	9 occurred 9 no project 6 not applicable	58 2 no limit	≈ 33 (57%)	1 exceeded 0 met	33	0 (0%)	0 exceeded 0 met
Pipeline	6 opinions 6 projects	5 occurred 1 no project	60	3 (5%)	1 exceeded 0 met	17	0 (0%)	0 exceeded 0 met
Land Sale/ Exchange	5 opinions 5 projects	1 occurred 2 no project 1 unknown 1 not applicable	50	6 (12%)	0 exceeded 0 met	5	0 (0%)	0 exceeded 0 met
Landfill	6 opinions 6 projects	6 occurred	490	≈ 187 (38%)	1 exceeded 0 met	444	**1** (0.2%)	0 exceeded 0 met
Flood Control	9 opinions 9 projects	4 occurred 5 no project	226	107 (47%)	1 exceeded 0 met	99	**2** (2%)	1 exceeded 0 met
Miscellaneous	1 opinion 1 project	1 occurred	25	1 (4%)	0 exceeded 0 met	5	0 (0%)	0 exceeded 0 met
Train	1 opinion 1 project	1 no project	N/A	N/A	N/A	N/A	N/A	N/A
10 types of projects	108 opinions 140 projects	68 occurred 33 no project 7 not applicable 1 unknown	1,742 4 No limit	≈536 (31%)	6 exceeded 2 met	702	**6** (0.8%)	1 exceeded 0 met

Table D-3. Terms and Conditions Required for Projects Occurring in California.

Only California Projects That Have Occurred (No. opinions)	**Terms and Conditions Common to Eagle Mountain**								
	a. Buy land	**b.** Revoke permit	**c.** Field contact	**d.** Tortoise awareness program	**e.** Check beneath vehicles	**f.** Define work zone	**g.** On-site monitor	**h.** Tortoise proof fences	**i.** Project end report
Mines 19 opinions	16 (84%)	5 (26%)	15 (79%)	19 (100%)	14 (74%)	19 (100%)	19 (100%)	13 (68%)	12 (63%)
Highways 10 opinions	5 (50%)	2 (20%)	8 (80%)	10 (100%)	7 (70%)	9 (90%)	10 (100%)	7 (70%)	7 (70%)
Utilities 15 opinions	8 (53%)	4 (27%)	11 (73%)	15 (100%)	8 (53%)	15 (100%)	15 (100%)	7 (47%)	14 (93%)
Tract/Parcels 13 opinions	5 (38%)	2 (15%)	10 (77%)	13 (100%)	11 (85%)	13 (100%)	13 (100%)	11 (85%)	8 (61%)
Pipelines 19 opinions	10 (53%)	6 (32%)	14 (74%)	19 (100%)	12 (63%)	19 (100%)	19 (100%)	7 (37%)	13 (68%)
Programmatic 13 opinions	0 (0%)	2 (15%)	10 (77%)	12 (92%)	8 (61%)	8 (61%)	12 (92%)	8 (61%)	11 (85%)
Miscellaneous Military 7 opinions	0 (0%)	1 (14%)	6 (86%)	7 (100%)	3 (43%)	5 (71%)	6 (86%)	3 (43%)	5 (71%)
Landfills 2 opinions	1 (50%)	0 (0%)	2 (100%)	2 (100%)	0 (0%)	2 (100%)	2 (100%)	2 (100%)	2 (100%)
Hazardous Material Disposal 1 opinions	0 (0%)	0 (0%)	1 (100%)	1 (100%)	1 (100%)	0 (0%)	1 (100%)	0 (0%)	1 (100%)
Flood Control (1 No Project)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Miscellaneous 2 opinions	0 (0%)	0 (0%)	1 (50%)	2 (100%)	0 (0%)	2 (100%)	2 (100%)	2 (100%)	0 (0%)
101 opinions	45 (44%)	22 (22%)	78 (77%)	100 (99%)	64 (63%)	92 (91%)	99 (98%)	60 (59%)	73 (72%)

Table D-4. Terms and Conditions Required for Projects Occurring in Nevada.

All Nevada Projects Including Those That Have and Have Not Occurred (No. opinions)	**Terms and Conditions Common to Eagle Mountain**								
	a. Buy land	**b.** Revoke permit	**c.** Field contact	**d.** Tortoise awareness program	**e.** Check beneath vehicles	**f.** Define work zone	**g.** On-site monitor	**h.** Tortoise proof fences	**i.** Project end report
Mines 17 opinions	0 (0%)	0 (0%)	15 (88%)	17 (100%)	0 (0%)	16 (94%)	16 (94%)	16 (94%)	1 (6%)
Highways 16 opinions	0 (0%)	0 (0%)	14 (87.5%)	16 (100%)	5 (31%)	16 (100%)	16 (100%)	6 (37.5%)	2 (12.5%)
Utilities 23 opinions	0 (0%)	0 (0%)	19 (83%)	22 (96%)	13 (56%)	21 (91%)	23 (100%)	15 (65%)	3 (13%)
Tract/Parcels 24 opinions	0 (0%)	0 (0%)	22 (92%)	24 (100%)	3 (12.5%)	24 (100%)	24 (100%)	23 (96%)	1 (4%)
Pipelines 6 opinions	0 (0%)	0 (0%)	4 (67%)	6 (100%)	4 (67%)	6 (100%)	6 (100%)	4 (67%)	2 (33%)
Land Sales and Exchanges 5 opinions	0 (0%)	0 (0%)	5 (100%)	5 (100%)	0 (0%)	5 (100%)	5 (100%)	4 (80%)	0 (0%)
Landfills 6 opinions	0 (0%)	1 (17%)	4 (67%)	6 (100%)	0 (0%)	4 (67%)	6 (100%)	6 (100%)	2 (33%)
Flood Control 9 opinions	0 (0%)	0 (0%)	8 (89%)	9 (100%)	6 (67%)	9 (100%)	9 (100%)	8 (89%)	3 (33%)
Miscellaneous 1 opinions	0 (0%)	0 (0%)	1 (100%)	1 (100%)	1 (100%)	0 (0%)	1 (100%)	0 (0%)	0 (0%)
Trains 1 opinions	0 (0%)	0 (0%)	1 (100%)	1 (100%)	1 (100%)	1 (100%)	1 (100%)	1 (100%)	0 (0%)
108 opinions	0 (0%)	1 (0.9%)	93 (86%)	107 (99%)	33 (31%)	102 (94%)	107 (99%)	83 (77%)	14 (13%)

Table D-5. Non-core Conditions Required for All Projects in California, Including Those That Have Not Occurred.

Opinion No. Date	Project Status	Project Specific Terms and Conditions and Measures Developed by Mine Reclamation Corporation and Bureau of Land Management Found in Other Federal Biological Opinions											
Mines		j.	k.	l.	m.	n.	o.	p.	q.	r.	s.	t.	u.
1-8-95-F-15 (4/95)	Occurred											X	
1-6-92-F-54 (10/92)	No Project		X	X		X						X	
Highways													
1-8-94-F-51 (12/94)	No Project											X	
1-6-92-F-51 (8/92)	Occurred											X	
1-6-90-F-31 (6/90)	Occurred			X									
1-6-90-F-6 (11/89)	Occurred			X									
Utilities													
1-8-94-F-53 (1/94)	Occurred											X	
1-8-94-F-5 (4/94)	Occurred											X	
1-6-92-F-27 (4/92)	Occurred					X						X	
1-6-91-F-6 (2/91)	Occurred								X			X	
1-6-91-F-8 (1/91)	No Project					X							
1-6-89-F-61 (10/89)	Occurred			X		X							

j. = Install ballasts k. = Culverts under railroad l. = Culverts under road m. = Cover refuse
n. = Monitor ravens o. = Remove roadkills p. = Monitor railway use q. = Monitor tortoise population
r. = Fence landfill s. = Chemical raven deterrent t. = Eliminate ravens u. = Conservation trust fund

Table D-5. Non-core Conditions Required for All Projects in California, Including Those That Have Not Occurred.

Opinion No. Date	Project Status	Project Specific Terms and Conditions and Measures Developed by Mine Reclamation Corporation and Bureau of Land Management Found in Other Federal Biological Opinions											
Tracts/Parcels		j.	k.	l.	m.	n.	o.	p.	q.	r.	s.	t.	u.
1-8-94-F-48 (10/94)	Occurred											X	
1-8-93-F-34 (1/94)	Occurred											X	
1-6-90-F-42 (9/90)	Occurred					X							
Pipelines													
1-8-94-F-27 (1/95)	Occurred											X	
1-8-94-F-10 (4/94)	Occurred											X	
1-6-90-F-48 (10/90)	Occurred					X							
Programmatic plans													
1-6-90-F-19R (7/93)	Occurred								X				
1-6-90-F-54R (3/93)	Occurred			X					X				
1-6-90-F-54 (12/91)	Occurred					X			X				
1-6-90-F-19 (3/90)	Occurred								X				

j. = Install ballasts k. = Culverts under railroad l. = Culverts under road m. = Cover refuse
n. = Monitor ravens o. = Remove roadkills p. = Monitor railway use q. = Monitor tortoise population
r. = Fence landfill s. = Chemical raven deterrent t. = Eliminate ravens u. = Conservation trust fund

Table D-5. Non-core Conditions Required for All Projects in California, Including Those That Have Not Occurred.

Opinion No. Date	Project Status	Project Specific Terms and Conditions and Measures Developed by Mine Reclamation Corporation and Bureau of Land Management Found in Other Federal Biological Opinions											
Miscellaneous military		j.	k.	l.	m.	n.	o.	p.	q.	r.	s.	t.	u.
1-8-95-F-5 (12/94)	Occurred											X	
1-6-91-F-42 (9/91)	Occurred								X			X	
1-6-91-F-16 (3/91)	Occurred								X				
Landfills													
1-8-94-F-8 (4/94)	Occurred					X							
1-8-93-F-16 (8/93)	No Project				X	X				X		X	
1-6-92-F-61 (10/92)	Occurred					X				X		X	
Hazardous materials													
1-6-92-F-57 (10/92)	No Project		X	X		X						X	
Miscellaneous projects													
1-6-90-F-8 (12/89)	Occurred											X	
All Projects		0	2	6	1	11	0	0	7	2	0	18	0

j. = Install ballasts k. = Culverts under railroad l. = Culverts under road m. = Cover refuse
n. = Monitor ravens o. = Remove roadkills p. = Monitor railway use q. = Monitor tortoise population
r. = Fence landfill s. = Chemical raven deterrent t. = Eliminate ravens u. = Conservation trust fund

Table D-6. Non-core Conditions Required for All Projects in Nevada, Including Those That Have Not Occurred.

Opinion No. Date	Project Status	Project Specific Terms and Conditions and Measures Developed by Mine Reclamation Corporation and Bureau of Land Management Found in Other Nevada Federal Biological Opinions											
Utility		j.	k.	l.	m.	n.	o.	p.	q.	r.	s.	t.	u.
1-5-93-F-85 (5/93)	No Project			X									
Mines													
1-5-90-F-17, 36, 37, 38, and 39 (8/90)	Occurred												X
1-5-90-F-13 (3/90)	No Project			X									
Flood control													
1-5-90-F-25	Occurred			X									
Landfills													
10(a) Permit (9/94)	Occurred				X								X
1-5-94-F-61 (3/94)	Occurred				X					X			
1-5-93-F-173R (6/93)	Occurred				X								
Kerr-McGee (10/89)	Occurred		X	X					X	X			
Trains													
1-5-92-F-397 (9/92)	No Project		X	X									
All Projects		0	2	5	3	0	0	0	1	2	0	0	2

j. = Install ballasts k. = Culverts under railroad l. = Culverts under road m. = Cover refuse
n. = Monitor ravens o. = Remove roadkills p. = Monitor railway use q. = Monitor tortoise population
r. = Fence landfill s. = Chemical raven deterrent t. = Eliminate ravens u. = Conservation trust fund

APPENDIX E

ANNOTATED LIST OF PERSONS CONTACTED TO COMPLETE THIS REPORT

Ezra Abrahamy, of Jet Propulsion Laboratory, Pasadena, California. Re: biological opinion and take at Goldstone Deep Space Communication Complex in San Bernardino County, California, by telephone on 28 April 1995.

Mark Abrams of Placer Dome, Inc. Telephone conversation on 25 May 1995.

Steve Albert of Nevada Department of Wildlife in Reno. Telephone conversation on 23 May 1995.

Steve Ahmann of Fort Irwin. Telephone conversation on 19 May 1995. Left message on 14 June 1995. Telephone conversation on 23 June 1995 on follow-up.

Sherree Ames of Mead/Adelanto Project. Telephone conversation on 23 June 1995.

Nancy Andrews of the Department of Fish and Game, Lower Colorado Unit. Telephone conversations 15, 21 August re: bighorn sheep in Orocopias and Chocolate, mule deer.

Orlo Anderson, Site Manager of Mine Reclamation Corporation. Meetings on 30 January and 22 March 1995 and telephone conversation on 19 January 1995 for access to site and copies of maps of the area.

Richard Argo of Department of Housing and Urban Development. Telephone conversation 19 May 1995.

Randy Arnold, Tortoise Biologist of RCA & Associates of Hesperia, California. Called on 10 May 1995 with information on two projects on which he had worked that were authorized by section 7.

Terry Babich of the Seattle office of CH2M HILL. Discussed the significance thresholds for Eagle Mountain with Babich on 4 April 1995.

Don Baepler, Director of Harry Reid Center for Environmental Studies, University of Nevada Las Vegas. During numerous telephone conversations and a meeting on 5 April 1995, receive much information on the number of tortoises handled during their projects.

John Bare, of Nevada Power Company, Las Vegas, Nevada. Telephone conversation on 8 May 1995, re: projects they have worked on. Telephone conversation on 18 May 1995. Left message on 25 May 1995, 12 June 1995. Telephone conversation on 13 June 1995.

Sherry Barrett, Wildlife Biologist formerly of the Reno, Nevada office of the U.S. Fish and Wildlife Service. Meeting on 15 February 1995 to discuss the federal opinion analysis. (She is now in the Carlsbad, California office of the Service).

Mark Bittlecomb, Wildlife Biologist of the Tonapah, Nevada office of the Bureau of Land Management. Telephone conversation 12 April 1995, re: take for a facility constructed near Beatty, Nevada.

Bill Boarman, Wildlife Biologist and best regional expert on raven issues and roadway impacts relative to tortoises, of Riverside office of the Bureau of Land Management. Telephone conversation on 20 March 1995. Meeting on 1 April 1995. Telephone conversation on 15 May 1995, promised to send all information on ravens. Telephone conversations 30 June 1995, 1 August 1995.

Ray Bransfield, Wildlife Biologist of Ventura office of the U.S. Fish and Wildlife Service. Telephone conversations on 16 and 28 March 1995, indicated that he would speak with John Bradley in the Carlsbad office to gain access to their federal opinions. Left message on 19 May 1995, 14 June 1995. Telephone conversation on 15 June 1995.

Patricia Brown, private consultant, regional expert on bats. Left message 16 August to ask about significance criteria relative to bat species. Telephone conversation 21 August 1995, with info. on issues, mitigation.

Michael Burroughs, Wildlife Biologist of the Las Vegas, Nevada office of the U.S. Fish and Wildlife Service. Meeting on 16 February 1995, indicated that she knew of no projects currently implemented and monitored to determine the efficacy of fences and culverts to protect tortoises along roads.

Tom Campbell, of China Lake Naval Weapons Center, Ridgecrest, California. Called on 10 May 1995 with information on take of tortoises at China Lake. Receive biological opinion on 15 May 1995. Left message 18 July 1995.

Charlie Chew, of Southwest Gas Corporation. Telephone conversations on 14 April 1995 and 9 May 1995, re: several projects in Nevada where tortoises may have been handled. Telephone conversation on 18 May 1995.

Denise Cobb, of National Park Service. Telephone conversations 16 May 1995 and 19 May 1995.

Tim Cohen, of Woodward-Clyde Consultants. Telephone conversation on 14 April 1995 re: project on which they worked.

Jeanie Cole, Wildlife Biologist of the Las Vegas, Nevada office of the Bureau of Land Management. Telephone conversation on 20 March, 1995, and brief visits 30 March through 2 April 1995 to obtain the Bureau's information on federal opinions governing their projects. Telephone conversations on 13, 14 June 1995.

Gail Cotugena, of San Bernardino County Solid Waste Department, San Bernardino, California. Called on 10 May 1995 with information on the Victorville Landfill.

Peter Crookston, Wildlife Biologist of the Las Vegas, Nevada office of the Bureau of Land Management. During data collection between 30 March and 2 April 1995, Peter assisted with that collection. He also indicated that since he has been there (i.e., June 1992), he only knows of one tortoise that was killed under a federal opinion; that tortoise was killed during a motorcycle race event.

Peter Cross, of the Sacramento office of the Service. Left messages on 15, 30 June 1995.

Roger Dale, of Desert Tortoise Preserve Committee, San Bernardino, California. Telephone conversation on 9 May 1995 re: take of tortoises on the Veterans Home project in Barstow.

Art Davenport, Wildlife Biologist of Carlsbad office of the U.S. Fish and Wildlife Service. Telephone conversations on 19 and 24 January 1995 to get copies of appropriate cumulative effects analyses relative to tortoises. 26 June 1995 to follow up on magic gecko.

Tom Dayak, Wildlife Biologist of Caltrans, Bishop, California. Telephone conversations on 9 and 12 May 1995 to collect information on tortoises handled or killed along Highway 14.

Mark Dedon, of Pacific Gas and Electric. Called on 9 May 1995 regarding a project authorized under section 7 in the East Mojave Desert.

Mike DeKeryl, of the Barstow office of the Bureau of Land Management. Visit on 24 May 1995.

Nordo DeLuna, of DeLuna Engineering, Inc. Telephone conversation on 14 April 1995 re: a project his company engineered where tortoises may have been taken.

Jeanette Dinwiddie-Moore of Pacific Gas and Electric. Telephone conversation on 17 May 1995.

Tom Dodson, of Tom Dodson & Associates, San Bernardino, California. Indicated on 10 May 1995 that they were monitoring the Victorville Landfill project on which no tortoises have been handled or killed.

Dr. Charles Douglas, University of Nevada, Las Vegas, principal investigator of Eagle Mountain bighorn monitoring efforts. Telephone conversation on 10 August 1995 re: bighorn sheep. Telephone conversation to CH2M HILL in late January 1996 is also reported.

Tim Duck, Wildlife Biologist of St. George, Utah office of the Bureau of Land Management. Meeting on 16 February 1995 during which he indicated that he knew of no projects where fences and culverts were installed and monitored to determine if they work for tortoises.

Alice Dusel, of Chism Homes. Telephone conversation on 19 May 1995.

Katie Edson of Fort Irwin. Telephone conversation on 23 June 1995.

Tom Egan, Wildlife Biologist of Barstow office of the Bureau of Land Management. Telephone conversation on 15 March 1995 indicated that I would need to speak with the Area Manager, Tim Reed to gain access to their case files. Visit on 16 May 1995 to review files. Left message on 19 May 1995, 23 May 1995. Visit 24 May 1995. Telephone conversation on 14 June 1995.

Bill Fisher, of Southwest Division of the Department of the Navy, Barstow, California. Telephone conversation on 5 May 1995, shared information on take of tortoises.

Massoud Forbod, of Bechtel. Telephone conversation on 3 July 1995.

Larry Foreman, of the Riverside office of the Bureau of Land Management. Telephone conversations on 14, 15 June 1995.

Ray Fransen, of Viceroy (Castle Mountain Mine). Telephone conversation 18 May 1995.

Kathy Freas, terrestrial ecologist, CH2M HILL, 2485 Natomas Park Drive, Ste 600, Sacramento, CA 95833. Numerous conversations and meetings regarding technical report.

Jerry Freilich, Joshua Tree National Park. Meeting in Palm Springs on 16 June 1995. Telephone conversation on 18 July 1995 re: a specific biological opinion.

Paul Fromer, Biologist of RECON. Meeting on 4 January 1995 to discuss judge's concerns relative to desert tortoises, and by telephone on 19 January, 20 March 1995 to facilitate field surveys.

Steve Gardner, Tortoise Biologist. Part of field survey crew from 3 through 6 February 1995.

Ray Gerard, of Lewis Berger and Associates. Telephone conversation on 3 July 1995.

Peggy Goette, Tortoise Biologist. Telephone conversation on 13 April 1995 re: take of tortoises on several Nevada jobs.

Gilbert Goodlett, Enviro Plus Consulting. Telephone conversation on 17 May 1995.

Glenn Goodlett, of On Track Consulting & Research. Telephone conversation on 25 May 1995.

Kim Gould, Southern California Edison. Left message on 16 May 1995.

Patty Gould, of Ridgecrest. Left message on 25 May 1995.

Elliott Graham, District Ranger, Cajon Ranger District, San Bernardino National Forest. Telephone conversation on 17 July 1995 for info on railroads and fire.

Michelle Grasso, Tortoise Biologist in Las Vegas, Nevada. Grasso called with some information on 10 May 1995.

Jody Grizzle, of Nevada Paving Company, Inc. Telephone conversation on 16 May 1995.

Eric Greene, Tortoise Biologist. Telephone conversation on 13 April 1995 re: take of tortoises on several Nevada jobs.

Bob Gulash, of Terracon. Telephone conversation on 16 May 1995.

Mark Hagan, Wildlife Biologist of Edwards Air Force Base. Meetings on 16 February and 19 May 1995 and by telephone on 24 April 1995 to discuss the efficacy of tortoise mitigation measures at Edwards Air Force Base where 37 federal opinions have been issued for tortoises. Telephone conversation on 13 June 1995.

Don Haines, of RECON, San Diego, California. Telephone conversation on 10 May 1995, indicated that RECON has not monitored any projects authorized by section 7. Telephone conversation on 16 August 1995 re: tortoises on tracks.

Ross Haley, of National Park Service. Telephone conversation on 16 May 1995.

Brad Hardenbrook, of Nevada Department of Wildlife in Las Vegas. Telephone conversation on 23 May 1995.

Loretta Haynes, of Zond Systems, Inc. Left message on 19 May 1995. Telephone conversation on 22 May 1995.

Roger Harris, Wildlife Biologist of Larry Seeman Associates, Point Richmond, California. Telephone conversation on 10 May 1995 indicated that there were no deaths on a pipeline they had monitored, and promised to send a biological opinion that I do not have. Telephone conversation on 30 June 1995.

Kay Hazen, CH2M HILL. Meeting 16 June 1995 in Palm Springs.

Alex Heindl, Herpetologist of Harry Reid Center for Environmental Studies, University of Nevada Las Vegas. During several telephone conversations and a meeting on 5 April 1995, receive much information on the number of tortoises handled during their projects. Also by telephone on 28 June, 1995.

Mark Holden, Joshua Tree National Park. Meeting in Palm Springs on 16 June 1995.

Victor Horchar, Tortoise Biologist of VHBC Biological Consulting of California. Telephone conversation on 9 May 1995: information on section 7 authorized projects.

Frank Hoover, of California Department of Fish and Game. Telephone conversation on 16 May 1995.

Kip Jackson, of Mead/Adelanto Project. Telephone conversations on 25 May 1995, 14 June 1995.

Karen Jensen, US Fish and Wildlife Service, Carlsbad. Meeting on 16 June 1995 in Palm Springs. Left message 19 June 1995. Visit office on 22 June 1995. Telephone conversation on 8 August 1995 for info about status of several species.

Becky Jones, California Department of Fish and Game. Meeting on 16 June 1995 in Palm Springs. Calls and leaves message on 11 July 1995: she "and others within the Department" reviewed the Eagle Mountain species list provided on 16 June and found it to be complete; they did not have any additional species to add to the list. Telephone conversation on 7 August 1995. Faxes protocol for burrowing owl surveys.

Carolyn Kamine, of National Biological Service. Telephone conversation on 28 June 1995.

Alice Karl, Tortoise Biologist. Telephone conversations on several occasions discussing tortoises and part of field team 30 and 31 January 1995.

Lisa Kegarice, of Tom Dodson Associates. Telephone conversation on 28 June 1995.

Bob Kelly, of Owl Rock Mine Company. Telephone conversation on 9 May 1995 re: two federal opinions issued to Owl Rock. Telephone conversation on 16 May 1995.

Craig Kennedy, of Nevada Environmental Consultants. Telephone conversation on 18 May 1995.

Edward Kirwan, of American Girl Gold Mine, Imperial County, California. Telephone conversation on 4 May 1995 re: information on take.

Kenneth Knight, Wildlife Biologist with Knight and Leavitt of Las Vegas. Telephone conversation on 13 April 1995, discussed several projects.

Pam Knowles, independent consultant. Telephone conversation on 16 May 1995.

Chuck LaBarr, Tortoise Biologist of the Desert Tortoise Conservation Center, Las Vegas, Nevada. Telephone conversations on 20 March 1995 and 11 May 1995 to receive information on tortoises removed under authorization of section 7 in Nevada. Receive fax on 11 May with this information.

Denise LaBerteaux, of EREMICO, Onyx, California. Telephone conversation on 10 May 1995, indicated that she had worked on the Mojave-Kern pipeline and that Garlinger, her partner, had occasionally worked at Edwards Air Force Base.

Kathy LaBue, of Southdown Corporation. Telephone conversation on 23 May 1995.

Melody Lardner, Forest Botanist, San Bernardino National Forest. Left message on 17 July 1995 re: fire issues.

Dennis Laybourn of American Girl Mining Operations. Telephone conversations on 28 June 1995, 18 July 1995.

Chet Littledyke of Mesquite (Gold Fields) Gold Mine. Left message on 9 August 1995.

Patricia Lock-Dawson of the Palm Springs office of the Bureau of Land Management. Left message on 25 May 1995. Telephone conversation on 9 June, she says that she has found no evidence of dead tortoises for either Mesa Wind Facility or Small Mining Biological Opinion; will check to see if any tortoises handled. Left message 18, 19 July 1995. Conference call 1 August 1995, meeting 2 August 1995.

Jeff Lovich, of the National Biological Service. Meeting at Palm Springs on 16 June 1995. Telephone conversation 30 on June 1995. Telephone conversation on 6 July 1995, will be available after 12 July to discuss federal opinion research. Left message 19 July 1995. Meeting 2 August 1995. Left message 16 August 1995 re: fire.

Glenn Lukos, of Glenn Lukos Associates. Telephone conversation on 23 May 1995.

Ken MacDonald, of Dames and Moore. Left message on 18 May 1995. Telephone conversation on 19 May 1995.

Roy Madden, of Twentynine Palms Marine Corps Base, Twentynine Palms, California. Telephone conversation on 9 May 1995, re: information on three projects authorized at the Marine Corps Base.

Mark Maley, Wildlife Biologist of the Reno, Nevada of the U.S. Fish and Wildlife Service. Copied federal opinions with Maley's assistance between 13 and 15 February 1995. Discussed several projects, including landfill projects and fencing projects. Telephone conversation on 16 May 1995; Maley indicated that the Nellis Air Force Base contact is Eric Watkins. Telephone conversations on 25 May 1995 and 28 and 30 June 1995 to discuss information on the take of tortoises relative to the Las Vegas Beltway project.

Bob Manygoats, of SWCA in Flagstaff, Arizona. Telephone conversation on 14 April 1995 re: take of tortoises monitored by SWCA.

Jim Marble, of Revegetation Innovations. Telephone conversation on 23 May 1995.

Ron Marlow. Telephone conversation on 28 June 1995. Ron will send us his bibliography on the impacts of roads on tortoises.

Chief David Matis, California Department of Forestry, Riverside County, 210 W. San Jacinto, Perris, CA 92570. Telephone conversation on 17 July 1995, left message re: fire history, rail. Messages left 7, 10 August 1995. Leaves message 11 August 1995; has no information on area.

Dave Mayer, Conference call 1 August 1995.

Cheryl McDonnell-Canan, of Sierra Delta Corporation. Telephone conversations re: several projects on 14 April and 18 May 1995.

Patricia McClenahan, Joshua Tree National Park. Meeting in Palm Springs on 16 June 1995. Telephone conversation on 10 August 1995 re: bighorn sheep issues.

John McComb of AT&T. Left message on 19 May 1995.

David McCullough, Tortoise Biologist of McCullough Ecological Systems. Telephone conversations on 17 January and 13 April 1995 to facilitate collection of data in Nevada and to discuss take on projects on which he's worked.

Mike McGill, of the Needles Resource Area of the Bureau of Land Management. Telephone conversations on 23 and 25 May 1995.

George Meckfessal, of the Needles Resource Area of the Bureau of Land Management. Telephone conversation on 23 May 1995.

Floyd Meldurn, of Nevada Paving Company, Inc. Telephone conversation on 16 May 1995.

Mesquite Gold Mine. Left message 18 July 1995.

Chris Mitchell, of Viceroy (Castle Mountain Mine). Telephone conversations on 18 and 23 May 1995.

Don Mitchell, of Tetra Tech in San Bernardino, California. Telephone conversation on 28 April 1995 re: projects they may have worked on.

Richard Montijo, of Earth Technologies Corporation in Colton, California. Telephone conversation on 28 April 1995, discussed several projects at Edwards Air Force Base.

Jim Mueller, Wildlife Biologist of EG&G Energy Measurements. Following a meeting on 16 February 1995, he sent a copy of the Yucca Mountain, Nevada common raven monitoring study.

Gerald MulCahey, of the Department of Fish and Game. Telephone conversation on 15 August 1995, re: info about bighorn sheep in Orocopias and Chocolates

Ted Mullen, Wildlife Biologist of Science International Applications. Telephone conversation on 15 May 1995. Left message on 14 June 1995. Telephone conversation on 19 June 1995.

Nancy Nicolai, of the El Centro office of the Bureau of Land Management. Left message on 25 May 1995. Calls on 12 June 1995; says she will not be able to get the small mine information to me for about another month. Telephone conversation on 13 June 1995. Messages left 9, 10 August 1995. Telephone conversation on 11 August 1995.

Tom Olson, Wildlife Biologist for Dames and Moore, Santa Barbara, California. Returned call on 10 May 1995 with information on several projects. On 5 June 1995, sent a copy of the federal opinion for the Mojave-Kern pipeline. Telephone conversation on 14 June 1995.

Joan Oxendine, Bureau of Land Management, Palm Springs. Meeting in Palm Springs on 16 June 1995. Conference call 1 August 1995. Meeting 2 August 1995.

John Palmer, of Southern California Edison. Telephone conversation on 10 May 1995, suggested that we speak with Dan Pearson to determine take under section 7.

Bob Parker, of the Ridgecrest, California office of the Bureau of Land Management. Telephone conversation on 10 May 1995 re: take of tortoises in the Rand Mountains area. Left message on 23 May 1995. Telephone conversation on 25 May 1995.

Roger Patten, of Lewis Berger and Associates. Telephone conversation on 5 July 1995.

Cameron Patterson, Botanist of RECON. Meeting on 4 January 1995 to discuss judge's concerns relative to desert tortoises and part of field crew on 30 January 1995.

Dan Pearson, Southern California Edison. Left message and paged on 16 May 1995. Left message on 19 May 1995.

Tom Peters, Project Manager, CH2M Hill. Numerous telephone and conversations and several meetings to discuss the biological technical report.

William Pratt, of Harry Reid Center for Environmental Studies, University of Nevada Las Vegas. Telephone conversation on 4 April 1995, re: information on take of tortoises during their projects. Suggests that I speak with Dr. Baepler of the same facility.

Tim Reid, Area Manager of the Barstow office of the Bureau of Land Management. Telephone conversation on 20 March 1995, gives permission to view the Bureau's case files relative to section 7 consultations.

Ted Rado, Tortoise Biologist and Regulation Specialist. Numerous telephone conversations with Rado regarding mitigation measures and information for federal opinion analysis. Also drafted five page memorandum on 18 February 1995 addressing the feasibility of existing mitigation measures.

Kenneth Reinert. Left message 18 May 1995. Telephone conversation on 22 May 1995.

Christine Roberts, CH2M HILL. Meeting in Palm Springs 16 June 1995 and numerous telephone conversations.

Chris Robinson, of the City of Las Vegas. On 14 April 1995 discussed several Las Vegas projects with her. Telephone conversations on 19 May 1995, 24 May 1995. Left message on 12, 13 June 1995. Telephone conversation on 15 June 1995.

Gina-Marie Robinson, of the City of Ridgecrest. Telephone conversation on 18 July 1995.

Dave Roddy, Tortoise Biologist. Part of field survey crew from 1 through 6 February 1995.

George Rogers, of Silver State Disposal Company in Nevada. Telephone conversation on 13 April 1995, discussed take of tortoises on their site.

Dolores Savignon, Wildlife Biologist of the Las Vegas, Nevada office of the U.S. Fish and Wildlife Service. Meeting on 16 February 1995, indicated that she knew of no projects currently implemented and monitored to determine the efficacy of fences and culverts to protect tortoises along roads.

Marc Sazaki, of California Energy Commission. Left message on 22 May 1995.

Cecil Schwalbe, Wildlife Biologist, National Biological Service, member of the Recovery Team for the desert tortoise. Meeting on 16 February 1995, indicated that common ravens are not identified as a major threat to tortoises in Arizona. Aside from Dr. Boarman's study on Highway 58, did not know of any projects using fences and culverts.

Paul Selzer, Attorney, of Best, Best, & Krieger. Meeting on 4 January 1995 to discuss judge's concerns relative to desert tortoises. Meeting on 16 June 1995 in Palm Springs.

Parag Shah, CH2M HILL Calls on 21 June 1995 for info on graphics needs. Telephone conversation on 23 June 1995. Leaves message 12 July 1995. Call back with info. on where to get a copy of Desert Tortoise Recovery Plan on 13 July 1995.

Gina Shultz, Biologist, formerly of RECON, as of April 1995 of U.S. Fish and Wildlife Service, Carlsbad office. Part of field crew on 30 January 1995. Telephone conversation on 10 May 1995 as a Service representative re: access to federal opinions. Telephone conversation on 16 May 1995.

Antal Sjizz, of the Army Corps of Engineers. Telephone conversation 23 May 1995.

Sid Sloan, Biologist of the Las Vegas, Nevada office of the Bureau of Land Management. Brief meeting on 6 April 1995, indicated that he was not aware of any projects authorized by the Bureau where tortoises had been killed.

Dan Smith, of Kenetech Windpower. Telephone conversation on 19 May 1995.

Jim Smith, of Pacific Gas and Electric. Telephone conversation on 9 May 1995 with information on a pipeline in the Old Woman Mountains, East Mojave Desert.

Pete Sorensen (619-431-9440) of Carlsbad office of the U.S. Fish and Wildlife Service. Telephone conversation on 2 March 1995, to facilitate copying of federal opinions filed in Carlsbad.

Lou Stabley, of Cellular One in Las Vegas, Nevada. Telephone conversation on 14 April 1995, re: one of their projects.

Stan Stevens, of AT&T. Telephone conversation on 19 May 1995.

Scott Stonum, Joshua Tree National Park. Meeting in Palm Springs on 16 June 1995.

Tim Sutko, of Clark County Flood Control. Telephone conversations on 17, 25 May 1995.

Craig Swengel, of Black and Veech. Telephone conversation on 5 July 1995, re: the Las Vegas Beltway project.

David Syzdek, of Clark County Desert Tortoise Conservation Center. Telephone conversation on 23 May 1995.

Bob Taylor, of Bureau of Land Management, Las Vegas. Left message on 19 May 1995, 25 May 1995. Returns call on 12 June 1995, but still unable to talk to him.

Dick Thomas, of David Evans and Associates. Telephone conversation on 22 May 1995.

Steve Torres, statewide coordinator for bighorn sheep, California Dept. of Fish and Game, Sacramento. Left message 10 August 1995 re: bighorn in Orocopia and Chocolate Mountains. Calls 15 August 1995 with info and suggestions for mitigation.

Bob Turner, of Converse. Telephone conversations on 16 May 1995 and 18 May 1995.

Jim Voorhees of Mesquite (Gold Fields) Gold Mine (619-352-6541). Left message on 9 August 1995.

Sharyl Walker, Attorney, of Hill-Walker. Meeting on 4 January 1995 to discuss judge's concerns relative to desert tortoises, and by telephone on 18 January 1995 re: access onto mine site. Meeting 16 June 1995, Palm Springs.

Kirk Waln, Wildlife Biologist of Ventura office of the U.S. Fish and Wildlife Service. Telephone conversations on 17 January, 21 February, 28 March, and 4 May 1995 re: collection of federal opinion data and appropriateness of mitigation measures. Left message on 14 June 1995.

Eric Watkins, of Nellis Air Force Base. Telephone conversations on 16 May 1995, 23 May 1995.

Rob Waywood of the Riverside office of the Bureau of Land Management. Telephone conversation on 24 May 1995.

John Wear, of Lilburn Corporation, San Bernardino, California. Meeting on 8 May 1995 re: projects on which they have worked authorized by section 7.

Richard Wellington, of Southern Nevada Water Company. Telephone conversation on 25 May 1995.

Bob Wickenden, of Nye County, Nevada. Telephone conversation on 16 May 1995.

Bernette Woodall, of the City of Henderson, Nevada. Telephone conversation on 25 May 1995.

Peter Woodman, Tortoise Biologist of Kiva Biological Consulting. Numerous telephone conversations discussing tortoises and part of field survey crew from 30 January through 6 February 1995. Telephone conversation on 20 May 1995 re: projects they have monitored. 5 June 1995, he calls with information on sensitive species found in the area.

Nancy Woods, of Caltrans, San Bernardino, California. Meeting on 8 May 1995 to discuss tortoises that have been handled or killed during Caltrans project.

Mike Ynnone, of Southdown Corporation. Telephone conversation on 19 June 1995, re: some follow-up on biological opinions.

Gary Zunino, Statewide Biologist of Nevada Department of Transportation, Carson City, Nevada. Telephone conversation on 27 March 1995; indicated that he would help us with the follow-up on NDOT's projects. Receive his letter response on 15 April 1995.

APPENDIX F

Relevant Expertise of Circle Mountain Biological Consultants

Ed LaRue and Sharon Dougherty comprise Circle Mountain Biological Consultants. From 1979 to 1983, Ed worked for the U.S. Fish and Wildlife Service at Patuxent Wildlife Research Center in Laurel, Maryland, and was on the Puerto Rican Parrot Project from 1983 through 1986. In 1986 Sharon and Ed both worked for the U.S. Forest Service and U.S. Fish and Wildlife Service on the Puerto Rican Parrot Project in El Yunque, Puerto Rico. In 1988, for The Nature Conservancy, they worked with endangered bird colonies on Long Island, New York. Ed obtained his Master's Degree from Ohio State University in 1987, and in 1988, Sharon received her Master's Degree from Yale University's School of Forestry and Environmental Studies.

Ed worked for Tierra Madre Consultants, Inc. from 1989 to 1994, where he served as Senior Biologist (1989 through 1991) and Vice President (1992 to 1994). Ed was project manager and technical report writer for about 200 projects during those five years. Sharon worked for the San Bernardino National Forest from 1989 to 1994. She served as District Wildlife Biologist for the Cajon Ranger District, in Lytle Creek, California. From 1992 to 1994, she also served as Resources Staff Officer, managing wildlife, timber, forest products, range, and watershed programs for the 124,181-acre district. Circle Mountain Biological Consultants was established in March 1994.

Between 1989 and 1994, Ed and Sharon completed fieldwork and drafted reports for U.S. Forest Service, George Air Force Base, Caltrans, Riverside County Flood Control, San Bernardino County Special Districts, San Bernardino County Planning Department, City of Lancaster, City of Victorville, Victor Valley Economic Development Authority, City of Palm Desert, Town of Yucca Valley, Mojave Water Agency, Indian Wells Valley Water District, Hi-Desert Water District, Twentynine Palms Water District, CalMat, Specialty Minerals, Mitsubishi Cement Corporation, and Pluess-Staufer, to name a few.

Since 1994, Circle Mountain has completed reports for Edwards Air Force Base, March Air Force Base, National Aeronautics and Space Administration, U.S. Army Corps of Engineers, U.S. Fish and Wildlife Service, U.S. Bureau of Land Management, California Department of Fish and Game, LG&E Power Engineers and Constructors, Kenetech Windpower, Inc., Tetra Tech, Inc., Terra Nova Planning and Research, Brian Mooney Associates, Jacobs Engineering, The Holt Group, Warner Engineering, Joshua Basin Water District, Coachella Valley Water District, Riverside County Waste Resources Management District, City of Barstow, City of Rancho Mirage, American Motorcyclists Association, and Twentieth Century Fox, to name a few. Following are a few project descriptions:

PROPOSED AND EXISTING LANDFILL AND REPOSITORY PROJECTS

1989 to 1993 *Broadwell Dry Lake Hazardous Waste Repository*
Contracted with Tom Dodson & Associates, on behalf of Broadwell Corporation:
Performed focused desert tortoise surveys adjacent to 8-mile long Crucero Road, on a 420-acre borrow site, at an 18-acre facilities site, and on various geological test sites. Drafted environmental documents relative to the proposed project.
Reference: Tom Dodson, Tom Dodson & Associates.

1993 *Blythe Landfill Expansion*
Contracted with Riverside County Waste Management:
Performed focused desert tortoise survey on the 270-acre site in northern Blythe, California. Afterwards drafted a Conservation Strategy for landfill operations that was accepted by the U.S. Fish and Wildlife Service, Carlsbad, California. Conducted desert tortoise education program for landfill employees and various landfill users to inform them of desert tortoise presence and issues.
Reference: Robert Nelson, Riverside County Waste Management.

1993 ***Edom Hill Landfill Expansion Project***
1994 Contracted with EMCON, on behalf of Riverside County Waste Management:
Surveyed for desert tortoises and other special-status species on this 640-acre site. Worked closely with RECON on drafting the biological document for this project. Performed pitfall trapping survey for local sensitive crickets.
Reference: Lesley Likins and Kathy Gifford, Riverside County Waste Management.

1995 ***Blythe Landfill Environmental Compliance***
Contracted with Riverside County Waste Resources Management District:
Surveyed for desert tortoises and advised Riverside County on fencing strategy and other measures to ensure regulatory compliance.
Contact: Kathy Gifford, Riverside County Waste Resources Management District.

ENDANGERED SPECIES ACT PERMITTING

1993 ***Yucca Valley Church Site Federal 10(a)(1)(b) and State 2081 Incidental Take Permits***
Contracted with Western Hills Realty, on behalf of Good Shepherd Lutheran Church and Valley Community Chapel:
Performed surveys in 1990 and again in 1992, found tortoises on the site, drafted the Habitat Conservation Plan, Implementation Agreement, and Environmental Assessment that resulted in the issuance (30 August 1993) of California's first Federal Incidental Take Permit [10(a) Permit] for desert tortoises. Additionally, drafted State Management Agreement and State Management Permit that resulted in the issuance of a State 2081 Incidental Take Permit in February 1993.
Reference: Ray Bransfield, U.S. Fish and Wildlife Service and Frank Hoover, California Department of Fish and Game.

1990 ***Sunland Communities Federal 10(a)(1)(b) and State 2081 Incidental***
1994 ***Take Permits***
Contracted with Sunland Communities:
Surveyed the 160-acre site in western Victorville and found tortoises. Drafted documents resulting in issuance of State 2081 Permit for the project, where 320 acres of California Department of Fish and Game-designated Crucial Habitat were acquired and deeded to the State as partial compensation for impacts. The Federal 10(a) permit issued in August 1994, was California's second permit for the authorized, incidental take of tortoises; California's first such permit was issued for the project described in the previous paragraph. To our knowledge, there has not yet been a third Federal permit issued.
Reference: Judy Hohman, U.S. Fish and Wildlife Service and Dave Showers, California Department of Fish and Game.

PROGRAMMATIC PLANS AND PROJECTS

1991 ***Lancaster Mohave Ground Squirrel/Desert Tortoise Surveys***
Contracted with the City of Lancaster:
Supervised a project that included Cumulative Human Impact Evaluations for Mohave ground squirrel and surveys for tortoise within 150 square miles of the city limits and sphere of influence for the City of Lancaster, California.
Reference: Brian Hawley and Susan Barnett, City of Lancaster.

1993 ***Yucca Valley General Plan***
Contracted with Terra Nova Planning & Research, on behalf of the Town of Yucca Valley, California:
Drafted the technical biological report for the Draft Yucca Valley General Plan. Between 1989 and 1993 conducted the majority of the focused desert tortoise surveys that have been performed in Yucca Valley.
Reference: John Criste, Terra Nova Planning & Research and Shane Stueckle, Town of Yucca Valley Planning Department.

1996 ***Rancho Mirage General Plan***
Contracted with Terra Nova Planning and Research, Inc. on behalf of City of Rancho Mirage, California:
Drafted biological technical report for the General Plan, including exhaustive assessment of special-status species occurring in the area, potential impacts to those resources, and recommendations for conservation and open space planning governing future development.
Contact: John Criste, Terra Nova Planning and Research, Inc.

MILITARY AND FEDERAL INSTALLATION PROJECTS

1992 ***George Air Force Base Redevelopment Plan***
Contracted with Urban Futures, on behalf of Victor Valley Economic Development Authority:
Drafted technical biological report for the redevelopment plan for the closing of George Air Force Base, including an issues analysis for the impact of the plan on the biological resources in the adjacent cities and towns of Victorville, Apple Valley, and Hesperia.
Reference: Scott Priester, City of Victorville.

1992 ***Goldstone Fiber Optics Cable Survey***
1993 Contracted with Jet Propulsion Laboratory:
Led the survey team along a nine-mile long fiber optics cable on NASA's Goldstone Deep Space Communications Complex, an inholding of Fort Irwin, for the detection of desert tortoise sign and completion of Cumulative Human Impact Evaluations for Mohave ground squirrels. In 1993 supervised construction along the cable route.
Reference: Ezra Abrahamy, Fred Battle, Jet Propulsion Laboratory.

1994 ***Edwards Air Force Base Mohave Ground Squirrel Trapping & Tortoise Surveys***
Contracted with Tetra Tech, Inc. on behalf of Army Corps of Engineers and Edwards Air Force Base:
Trapped for Mohave ground squirrels for approximately seven weeks during April and May 1994. Then served as one member on a three-member crew to survey for desert tortoises over 105 miles of the Base.
Reference: Mark Hagan, Edwards Air Force Base and Don Mitchell, Tetra Tech, Inc.

1995 ***Goldstone Deep Space Communications Complex Environmental Compliance***
Contracted with Jacobs Engineering Group, Inc. on behalf of Jet Propulsion Laboratory:
Performed focused desert tortoise and rare plant surveys on the Complex. On call monitor to ensure compliance with Federal Biological Opinion for installation of deep space antennas at the Apollo Site. Informal consultant for proposed fiber optic cable and other projects tentatively affecting desert tortoises and other special-status resources on the Complex.
Reference: Hector Ortiz, Jacobs Engineering Group, Inc. and Fred Battle, Jet Propulsion Laboratory.

1995 ***Asbestos Clean-up Project for March Air Force Base***
Contracted with Tetra Tech, Inc. on behalf of U.S. Army Corps of Engineers and March Air Force Base:
Following a focused tortoise survey, Circle Mountain drafted a Conservation Strategy and obtained concurrence from the Fish and Wildlife Service that formal consultation was not required. Served as liaison between Corps and Service to allow clean up of the radio relay tower near Hinkley, approximately 15 miles west of Barstow, California. Then monitored clean up activities for three weeks during the end of September and first of October, 1995.
Contacts: Elaine Silvestro, Tetra Tech, Inc.

PIPELINE AND WATER DISTRICT PROJECTS

1991 to 1996 *Joshua Basin 106-mile Water Pipeline*
Contracted with Krieger & Stewart, on behalf of Joshua Basin Water District:
Led a survey crew for desert tortoises on a 106-mile long pipeline located in Joshua Tree, California. Later helped facilitate the issuance of a State 2081 Permit (reviewed document drafted by Paul Selzer) and Section 7 consultation for this project. Circle Mountain has facilitated the regulatory compliance with Housing and Rural Economic Development Authority (i.e., old Farmer's Home Administration) and will monitor installation of this pipeline beginning February 1996.
Reference: Susan Barone, Joshua Basin Water District.

1992 1993 *Morongo Basin Pipeline*
Contracted with Tom Dodson & Associates, on behalf of Mojave Water Agency:
Served as Federal Field Contact Representative for the Section 7 authorized Morongo Pipeline project. Supervised eight tortoise monitors during the year-long project where the 70-mile long water pipeline was installed between Hesperia and Landers, California. No tortoises killed, one moved out of harm's way.
Reference: Tom Dodson, Tom Dodson & Associates and Don Orcutt, Bechtel Corporation.

1994 *Coachella Valley Water Tank and Access Road: Resource Inventory*
Contracted with Terra Nova on behalf of Coachella Valley Water District:
Performed focused surveys, finding common chuckwalla and loggerhead shrike. Major issue included avoiding riparian vegetation and minimizing impacts to State-listed Peninsular bighorn sheep.
Reference: John Criste, Terra Nova Planning & Research

TRANSPORTATION PROJECTS

1992 *Interstate 15/Interstate 40 Interchange Widening & Realignment*
Contracted with Boyle Engineering, on behalf of Caltrans:
Performed surveys for the widening and realignment of I-15 and I-40 in Barstow, California. Tortoises were found during the project, and Mohave ground squirrel Cumulative Human Impact Evaluations were completed.
Reference: Walt Lyons, Boyle Engineering and Nancy Woods, Caltrans.

1994 *Lenwood Loop Connector Road*
Contracted with City of Barstow:
Between August 1 and December 1994, served as Field Contact Representative and lead biological monitor for this Barstow project. During project, handled seven tortoises on 11 occasions, and kept daily track of over 90 tortoise burrows along the federally- and state-authorized project. Facilitated agreement with the State that allowed for construction to proceed two months prior to actual issuance of the State permit.
Reference: Mike Bellomy, Paul Warner, City of Barstow Planning Department.

1995 *Harper Lake Road Environmental Compliance*
Uncontracted work on behalf of Desert Tortoise Preserve Committee:
LaRue serves as Field Contact Representative and environmental compliance facilitator for fencing of the Harper Lake Road between Highway 58 and Lockhart Road. The project is authorized by a Federal Biological Opinion from the Fish and Wildlife Service, with the Bureau of Land Management as the Federal Lead Agency.
Contact: Tom Egan, Bureau of Land Management and Dr. Kristin Berry, National Biological Service

Proposed Eagle Mountain Landfill Project:

Supplement to Biological Technical Report:

Focused Plant Surveys and Other Observations

Prepared for:
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June 1996

Executive Summary

Plants.

- CMBC spent 30 hours surveying along Eagle Mountain Road and 61 hours on the landfill between 30 April and 3 May 1996, which of all surveys performed to date, was the best-timed survey. Although there was insufficient rainfall to support annual plant growth, CMBC did not consider this to be a significant limitation. We added 23 new plant species, including California ditaxis and las animas colubrina, to the previous known plant list. In spite of no rainfall since August 1995, 16 of the 23 new plants (69%) were annual plants identified from persisting parts from previous years.
- Five California ditaxis and three las animas colubrina were found along Eagle Mountain Road. The ditaxis all occur within about two miles of I-10; one of the colubrina is also about 1.9 miles north of I-10, 20 feet west of the road in a bulldozed berm. All ditaxis and the one colubrina would be lost. Other ditaxis may occur and be lost, although the impact is not considered to be significant; the same habitat occurs from Eagle Mountain to Chiriaco Summit and beyond. Two of the colubrina occur north of Victory Pass, more in the vicinity of the rail line: one of the plants is in a wash over which a rail line trestle crosses, approximately 20 feet west of the line; the other is about midway between the rail line and access road. Neither of the two will be directly impacted by road widening.
- Andrew Sanders of the University of California, Riverside herbarium reviewed our species list and made the following determinations for likelihood of occurrence, which differ from previous determinations (see Table 3-1, attached as Appendix 3.0. to this report).
    - *Ribbed cryptantha.* The "Moderate" probability of occurrence should be "Low" for all areas because of the lack of sand dunes on which it relies.
    - *California ditaxis.* The "High" for access road should be changed to "Occurs."
    - *Salton milk-vetch.* Should be "Absent" from access roads rather than "Low." The "Moderate" for the rail line should be "Low."
    - *Las animas colubrina.* Should be changed from "Low" along access road and moderate along rail line to "Occurs" for both.

Tortoises.

- 22 desert tortoise scat were found very near the center of the southeast, bermed area. These scat are all within a 100 by 100 foot area that has been bermed and collects standing water; rabbitfoot grass and "mud cracks" are indicative of occasional, persisting water. All these scat are likely from the same tortoise. However, another scat was found about 800 feet east of this impounded area, and may be the scat of a second tortoise. The ramifications are that any development within the bermed area could result in the take of one or more tortoises. While the biological opinion allows for the tortoise(s) to be handled, there should be provisions for compensating for the lost habitat. Development within the bermed area would result in the permanent loss of habitat, which like road widening, should be compensated and called out in the biological opinion. Lands acquired through the Trust Fund, for the same reasons they do not cover road widening, will not compensate for this loss.

Birds.

- Fifteen (15) new bird species were added, including Swainson's hawk, which is listed by the California Department of Fish and Game as Threatened. Two Swainson's hawks were observed, and should be marked as "occurs" for the landfill in Table 3-3 of our technical report. There will be no significant impacts to this species, so no mitigation measures are recommended.

Executive Summary

Plants

- CNPS' survey of [illegible] along Eagle Mountain Road and [illegible] on the landfill between 20 April and 4 May [illegible], [illegible] of all surveys [illegible] to date, was the [illegible] survey. Although there was insufficient rainfall to support annual plant growth, CNPS did not consider this to be a significant limitation. We added 23 new plant species, including California [illegible] and [illegible] to the [illegible] plant list. In spite of [illegible] rainfall [illegible], 23 of the 28 new plants [illegible] were annual plants [illegible] previous years.
- Two California [illegible] and three [illegible] were found along Eagle Mountain Road. The [illegible] all occur within about two miles of I-10; one of the [illegible] is about [illegible] miles north of I-10, 20 feet west of the road in [illegible]. All [illegible] Other [illegible] may [illegible] be lost, although the impact is not considered to be significant; the [illegible] occurs [illegible] Eagle Mountain [illegible] Chuckwalla [illegible]. Two of the [illegible] were north of [illegible]. Neither of the two will be directly impacted by road widening.
- Andrew Sanders of the University of California Riverside [illegible] and made the following recommendations for [illegible] of occurrence, which differ from previous [illegible] (see Table 3-1, [illegible] in Appendix 3.1 [illegible]):
  - [illegible]. The "Moderate" probability of occurrence should be "Low" for all areas because of the lack of [illegible] habitat.
  - California [illegible]. The "High" for access road should be changed to "Absent."
  - [illegible] should be "absent" from access roads rather than "Low". The "Moderate" for the rail line should be "Low."
  - [illegible]. Should be changed from "Low" along access road and moderate along rail line to "Occurs" for both.

Tortoises

- 22 desert tortoise [illegible] were found very near the center of the southeast borrow area. These [illegible] are all within a 100 by 100 foot [illegible] standing water, [illegible] and "mud [illegible]" are [illegible] indicators of [illegible]. However, [illegible] area [illegible]. This [illegible] development within the [illegible] area [illegible] take of one or more tortoises. [illegible] Development within the [illegible] would result in the [illegible] take of tortoise, which [illegible]. Lands acquired [illegible]. For the same reasons they do not cover road widening [illegible] for the take.

Birds

- Fifteen (15) new bird species were added, including Swainson's Hawk, which is listed by the California Department of Fish and Game as Threatened. Two Swainson's Hawks were observed, and should be marked as "Occurs" for the [illegible] in Table 3.[illegible] of [illegible] report. There will be no significant impacts to this species, so no mitigation measures are recommended.

Proposed Eagle Mountain Landfill Project:
Supplement to Biological Technical Report:
Focused Plant Surveys and Other Observations

1.0. Introduction

In February 1996, Circle Mountain Biological Consultants (CMBC) completed a technical report for the proposed Eagle Mountain Landfill Project (Circle Mountain Biological Consultants 1996). In that report, we summarized the field surveys that had been performed for this Project. Surveys have included biological resource inventories performed by RECON between October 30 and November 11, 1989, November 28, 1989, and June 24, 1990 (RECON 1991) and by CMBC between January 30 and February 5, 1996 and March 22, 1996. Except for the five-hour reconnaissance survey on March 22, none of the surveys has been performed at an appropriate time of year to detect some of the special-status plant species that may occur in the Project area.

Therefore, at the request of CH2M HILL, CMBC and its subcontractors performed focused floral surveys of the Project area during late April and early May, 1996. This survey, then, is the only one that has focused on plants and been performed at a time of year when most of the sensitive plants reported from the area could have been detected. Even so, RECON (1991) and CMBC (Circle Mountain Biological Consultants 1996) did find some of the special-status plant species, as briefly summarized in the results section of this report.

Herein we report the findings of our 1996 surveys. Although the surveys were focused on plants, other biological resources, including a new location for tortoises and one special-status bird species were observed and are reported. In the results section, we list the changes that should be made to our technical report (Circle Mountain Biological Consultants 1996) and the Draft Environmental Impact Statement/ Environmental Impact Report (Draft EIS/EIR) being prepared for Bureau of Land Management (Bureau) and Riverside County by CH2M HILL.

2.0. Methods

Prior to initiating field surveys, Larry LaPre of Tierra Madre Consultants, Inc. visited the University of California, Riverside Herbarium to borrow specimens of the special-status plants reported from the area. All surveyors studied these specimens to be familiar with them and to help develop search images for them. LaPre also spoke with Andrew Sanders, Herbarium Curator, about the likelihood of occurrence of the plants within the project area. Further, LaPre provided CMBC with specific location information on the plants, and background information, including life history information, drawings, and other materials that would assist us in identifying the plants.

Prior to field surveys, LaRue spoke to Botanist Roland DeGouverain with the Palm Springs office of the Bureau to determine how good this year was for annual plant growth. DeGouverain indicated that it was very poor throughout the lower Colorado Desert due to very little rainfall. He had not surveyed in the Eagle Mountain area, but based this opinion on observations further west in the Coachella Valley. Mark Bagley who had just completed botanical surveys to the north through the east and west Mojave Desert confirmed that this was a poor year for plant growth. Orlo Anderson of Mine Reclamation Corporation, who works daily at the Eagle Mountain Townsite, indicated that there had been no measurable precipitation since August 1995, when there was about one-half inch of rain. As such, these surveys were performed under conditions where almost no annual plant growth occurred, which would have affected the detectability of some of the plants, as discussed in the results section.

Focused plant surveys were performed between April 30 and May 3, 1996 throughout the existing landfill site and along Eagle Mountain Road. Meandering transects were surveyed throughout much of the landfill area. We surveyed approximately 20 to 30 feet east and west and parallel to Eagle Mountain Road between Interstate 10 and the Eagle Mountain Townsite, which allowed for good coverage of the area that would be impacted with road widening and rail line spur construction. All plants and animals observed were recorded in field notes. Those plants and animals that have not previously been identified are listed in Appendix 1.0. and Appendix 2.0., respectively.

Surveyors included Field Biologist Ed LaRue with CMBC (EL), Botanist Mark Bagley (MB), Botanist Denise LaBerteaux (DL) with EREMICO, Botanist Pam MacKay (PM), and Field Biologists Chet McGaugh (CM) and Steve Myers (SM), both with Tierra Madre Consultants, Inc. Using the abbreviations given after each name, the approximate survey times, places, and personnel are given in the following table. "Landfill" refers to the existing mine area, exclusive of the townsite, Eagle Mountain Road, and Kaiser Road; i.e., the area that would be developed as a landfill and recycling center. "Access Road" refers to Eagle Mountain Road and the rail line spur, south to Interstate 10 and north to the townsite.

Table 1-1
Survey dates, times, personnel, and locations for April-May 1996 focused plant surveys

Date (1996)	Times	Total Hours	Personnel	Location
30 April	1400 - 1900	20	EL, MB, DL, SM	Access road
1 May	0900 - 1500	24	MB, DL, SM, CM	Landfill
2 May	0815 - 1315 1440 - 1640	28	MB, DL, CM, PM	Landfill
2 May	1800 - 1930	3	MB, DL	Access road
3 May	0800 - 1115	6.5	EL, DL	Access road
3 May	0945 - 1230	2.75	MB	Landfill
3 May	1215 - 1300	1.5	EL, DL	Landfill
3 May	1400 - 1615	4.5	MB, DL	Landfill
4 days		**29.5 hours** **60.75 hours**	→→→→→→→→→→→ →→→→→→→→→→→	**Access road** **Landfill**

As reported in the above table, we spent approximately 30 hours surveying along Eagle Mountain Road and approximately 61 hours surveying areas comprising the proposed landfill area. These surveys and collaborative information received from Sanders and LaPre were sufficient to ascertain the presence of several species, the absence of others, and to reassess the likelihood of occurrence given in the technical report (Circle Mountain Biological Consultants 1996), as reported in the next sections.

3.0. Results

3.1. Common flora and fauna. Approximately 175 plant species have been previously identified along the rail line, access roads (including Eagle Mountain and Kaiser Roads), and on the proposed landfill site (Circle Mountain Biological Consultants 1996; RECON 1991). Twenty-three (23) additional species were identified during our 1996 surveys (Appendix 1.0.). Two of the 23 new species (see Section 3.2.) are considered rare. Each of them was addressed in previous reports by CMBC and RECON. As reported by DeGouverain and Bagley, this was a poor year for annual growth in the Eagle Mountain area. Only one or two annual plants identified this year were vegetative; all others were identified from previous year's growth. Even so, 16 of the 23 new plants identified (69%) were annuals.

The previous reports cited above have identified 1 fish, 10 reptile, 53 bird, and 22 mammal species occurring in all project areas. No new reptiles or mammals were added to the list during the 1996 surveys, although we did identify 15 additional bird species (Appendix 2.0.), including one special-status species (see Section 3.3.). Surveys were performed at an ideal time of year to detect many migrant species. In fact, 14 of the 15 new species observed, excluding only great-tailed grackle, were migrants.

3.2. Special-status plant species. Our technical report (Circle Mountain Biological Consultants 1996) addressed the likelihood of occurrence for 1 plant community and 23 plants that are considered rare by the Bureau, U.S. Fish and Wildlife Service (Service), California Department of Fish and Game (Department), and/or California Native Plant Society (CNPS). These plants were summarized in Table 3-1 of our technical report (see Appendix 3.0.).

During 1996 surveys we found three las animas colubrina (*Colubrina californica*) and five California ditaxis (*Ditaxis californica*). Neither of these plants had been found during previous surveys. All eight of these plants were found in the vicinity of the proposed Eagle Mountain access road as shown in attached maps (Appendix 4.0.). Aside from Alverson's foxtail cactus (*Escobaria vivipara* var. *alversoni*) and barrel cactus (*Ferocactus acanthodes*), which have been found during all surveys performed to date, no other rare plants were found on the landfill site where most of our survey effort occurred. As shown in Appendix 4.0., the following plants have been identified during previous surveys: Alverson's foxtail cactus throughout all areas; barrel cactus throughout all areas; Orocopia saga (*Salvia greatae*) along the rail line; desert unicorn plant (*Proboscidea althaeifolia*) along the rail line; and crucifixion thorn (*Castela emoryi*) along Kaiser Road and the rail line.

Given new information provided by LaPre and Sanders, we have reassessed the likelihood of occurrence for all plant species reported from the area. Table 3-1, Appendix 4.0. has been modified to show the new likelihood of occurrence for each plant, which is shown in **bold print** in the table and summarized as follows. Only those species that may have a higher or lower likelihood of occurrence than originally reported are discussed in this section.

Sanders indicated that *ribbed cryptantha* would only be found in sand dune habitats. Since there is no dune habitat in any of the project areas, we reassessed the probability of occurrence for this plant and list it as "Low" for all areas; it would be absent from all but the sandiest of areas. Given our findings of five *California ditaxis* along the access road, the "High" likelihood of occurrence along the access road has been changed to "Occurs." Sanders indicated that there is no likelihood of occurrence for *Salton milk-vetch* along either the access road or the landfill site, and very little likelihood along the rail line. Therefore, the "Moderate" likelihood of occurrence along the rail line has been changed to "Low." We now know that at least three *las animas colubrina* occur in the area; one beside Eagle Mountain Road and two north of there along the rail line. Therefore, the likelihood of occurrence for this plant has been changed to "Occurs" for the access road and rail line. Sanders' input does not require that we make any other changes; the likelihood of occurrence shown for each plant in Table 3-1 (Appendix 4.0.) is appropriate.

3.3. Special-status animal species. Previous reports by CMBC (1996) and RECON (1991) consider numerous special-status animal species that have been reported from the Eagle Mountain area and along the rail line to Salton Sea. There are only two changes required to our technical report as a result of these latest field surveys.

First, LaBerteaux positively identified two Swainson's hawks flying over the mine site during these plant surveys. We had indicated that there was a low likelihood of occurrence for the species to be found, and then only during migration. The two individuals observed were migrating through the area, very high up above the site. There is some possibility that they may occasionally forage in the area, but loss of potential foraging area is not considered significant. Some individuals migrate as far as South America and are seen in large flocks over Central America (Zeiner et al. 1990). They certainly forage along the way, maybe within the project area, but given their extensive range and the fact that they would not nest in the area (i.e., in California they nest in the northern San Joaquin Valley), we conclude that they would not be significantly impacted by the proposed project.

During surveys, LaRue found 22 new and older desert tortoise scat near the center of the southeast bermed area. Within the larger bermed area is a small area, approximately 100 by 100 feet square, where normal water flow has been impeded by a smaller berm. The 22 scat were found within this centrally-located spot where rain water persists enough to support rabbitfoot grass (*Polypogon monspeliensis*) and sunbaked mud. All 22 scat are likely from the same tortoise, which has been there for some time, as scat from previous years was also found. LaRue found another, newer scat (i.e., from this year) approximately 800 feet east of this bermed area. The scat may be from the same tortoise, but may also be from a different tortoise.

The Service's biological opinion (U.S. Fish and Wildlife Service 1992) allows for the accidental mortality of one tortoise per year and for the harassment (i.e., usually moving tortoises out of harm's way) of 160 tortoises per year. As such, the opinion accommodates potential impacts to the tortoise(s) residing within the bermed area. However, the biological opinion does not provide for compensation of lost tortoise habitat from this area. The entire bermed area is considered suitable tortoise habitat, the loss of which should be compensated, just as suitable habitat lost to widening Eagle Mountain Road is to be compensated. Measures required by the biological opinion to protect tortoises during construction should be implemented for all ground disturbing activities within the bermed area. For example, all areas must be surveyed prior to ground disturbance and a biological monitor would be required to oversee construction.

4.0. Conclusions

Even though the surveys were performed during a year of little rainfall, so that no new annual plant growth occurred along the access road and on the proposed landfill site, CMBC does not consider this to be a significant limitation. Of the plants with some likelihood of occurrence, only Utah vine milkweed (*Cynanchum utahense*) a twining herb, spearleaf (*Matelea parvifolia*) a vine often found on jojoba, and winged cryptantha (*Cryptantha holoptera*) may occur and may not have been detectable due to insufficient rainfall. The other plants are either absent from the area or are perennials that could have been detected during these focused surveys.

CH2M HILL indicated that it did not want to modify CMBC's technical report (Circle Mountain Biological Consultants 1996) at this late date, but rather asked that we draft this supplemental report to be attached to the technical report. The information given herein was provided to CH2M HILL via facsimile on 3 June 1996, which was soon enough that the new information will be included in the Draft EIS/EIR that will likely be distributed to the public during June or July 1996.

Aside from the new location for tortoises and the measures that should be implemented, there are no new measures recommended because of our findings. The loss of five California ditaxis and one las animas colubrina is not considered significant, and does not warrant any new mitigation measures. As already cited in our technical report, the las animas colubrina found beside the rail line and any other rare plants should be avoided during maintenance and repair activities. Observing Swainson's hawks over the site is to be expected but warrants no new measures. The occurrence probability for several plant species has changed based on information provided by LaPre and Sanders, as reported above and in Appendix 4.0. Except for the two new species found, the occurrence probabilities for two other species were changed to reflect that they were *less likely* to occur than previously expected. Therefore, these changes do not require any additional measures to be implemented.

It *is* important to inform the Carlsbad office of the Service about the new tortoise findings. As it is, the biological opinion only requires habitat compensation for impacts along Eagle Mountain access road; it should be amended or modified to require compensation for lost habitat from within the southeast bermed area.

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RECON. 1991. Biological technical report for the Eagle Mountain Landfill Project. RECON No. 2100B. San Diego, CA.

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Zeiner, D.C., W.F. Laudenslayer, Jr., K.E. Mayer and M. White, editors. 1990. *California's Wildlife. Volume II. Birds.* California Statewide Wildlife Habitat Relationships System. State of California. The Resources Agency. Department of Fish and Game. Sacramento, CA. 732 pp.

Appendix 1.0. New plants identified during April-May 1996 surveys

This list includes those plants that were newly identified (i.e., had not been previously identified in the Project area) during April and May 1996 surveys. It is to be used as a supplement to Appendix B of our biological technical report (Circle Mountain Biological Consultants 1996), which lists the plants that have been identified in previous surveys by CMBC and RECON.

FILICAE	FERNS
Pteridaceae	**Ferns**
Cheilanthes covillei	Lip fern
ANGIOSPERMAE: DICOTYLEDONES	DICOT FLOWERING PLANTS
Asclepiadaceae	**Milkweed family**
Asclepias erosa	Milkweed
Asteraceae	**Sunflower family**
Acamptopappus sphaerocephalus	Desert goldenhead
Atrichoseris platyphylla	Tobacco-weed
Chaenactis carphoclinia	Pincushion
Dyssodia porophylloides	Dyssodia
Geraea canescens	Desert sunflower
Perityle emoryi	Emory rock daisy
Prenanthella exigua	Prenanthella
Boraginaceae	**Borage family**
Cryptantha maritima	Angle-branched forget-me-not
Euphorbiaceae	**Spurge family**
Ditaxis californica	California ditaxis
Hydrophyllaceae	**Water-leaf family**
Phacelia crenulata	Purple phacelia
Malvaceae	**Mallow family**
Eremalche rotundifolia	Desert fivespot
Polemoniaceae	**Phlox family**
Linanthus c.f. *dichotomus*	Evening snow
Linanthus c.f. *jonesii*	Linanthus
Polygonaceae	**Buckwheat family**
Eriogonum c.f. *parishii*	Parish buckwheat
Eriogonum c.f. *thomasii*	Thomas buckwheat
Eriogonum thurberi	Thurber's buckwheat
Nemacladus sigmoideus	Nemacladus
Rhamnaceae	**Buckthorn family**
Colubrina californica	Las animas colubrina
Poaceae	**Grass family**
**Hordeum murinum*	Hare barley
Polypogon monspeliensis	Rabbitfoot grass
Vulpia octoflora	Six-weeks fescue

* - indicates a non-native (introduced) species.
c.f. - compares favorably to a given species when the actual species is unknown

Some species may not have been detected because of the seasonal nature of their occurrence. Common names are taken from Beauchamp (1986), Hickman (1993), Jaegar (1969), and Munz (1974).

Appendix 2.0. New animals identified during April-May 1996 surveys

As with the plants listed above, the following animals were not previously identified in the Project area by either CMBC or RECON. This list supplements Appendix B of the technical report (Circle Mountain Biological Consultants 1996).

AVES	BIRDS
Accipitridae	**Hawks, eagles, harriers**
Buteo swainsoni	Swainson's hawk
Apodidae	**Swifts**
Chaetura vauxi	Vaux's swift
Tyrannidae	**Tyrant flycatchers**
Contopus sordidulus	Western wood-pewee
Empidonax hammondii	Hammond's flycatcher
Empidonax wrightii	Gray flycatcher
Tyrannus vociferans	Cassin's kingbird
Tyrannus verticalis	Western kingbird
Hirundinidae	**Swallows**
Hirundo rustica	Barn swallow
Muscicapidae	**Thrushes and allies**
Catharus guttatus	Hermit thrush
Emberizidae	**Sparrows, warblers, tanagers**
Vermivora celata	Orange-crowned warbler
Wilsonia pusilla	Wilson's warbler
Piranga ludoviciana	Western tanager
Spizella passerina	Chipping sparrow
Melospiza lincolnii	Lincoln's sparrow
Quiscalus mexicanus	Great-tailed grackle

Nomenclature follows Stebbins, A Field Guide to Western Reptiles and Amphibians, the American Ornithologists' Union, Checklist of North American Birds, sixth edition, and Ingles, Mammals of the Pacific States.

Appendix 3.0. Special-status plants and plant communities reported from the region

Table 3-1 **Page 1 of 3**

Special-Status Plants and Plant Communities Reported from the Region

Common Name *Scientific name*	**[1]Federal status**	**[1]State status**	**[2]CNPS status**	**[3]Probability of occurrence**		
				Landfill site	**Access roads**	**Rail line**
Desert Fan Palm Oasis Woodland	ND	ND	CHIP	Absent	Absent	Absent
Utah Vine Milkweed *Cynanchum utahense*	ND	ND	List 4 R - 1 E - 1 D - 1	Low	Low	Low
Spearleaf *Matelea parvifolia*	ND	ND	List 2 R - 3 E - 1 D - 1	Low	Absent	Absent
Mesquite Neststraw *Stylocine sonorensis*	ND	ND	List 2 R - 3 E - 3 D - 1	Low	Low	Low
Mecca-aster *Xylorhiza cognata*	C2	ND	List 1B R - 2 E - 2 D - 2	Absent	Absent	Absent
Orcutt's Aster *Xylorhiza orcuttii*	C2	ND	List 1B R - 2 E - 2 D - 2	Absent	Absent	Absent
Ribbed Cryptantha *Cryptantha costata*	ND	ND	List 4 R - 1 E - 1 D - 2	Moderate **Low**	Moderate **Low**	Moderate **Low**
Winged Cryptantha *Cryptantha holoptera*	ND	ND	List 4 R - 1 E - 1 D - 2	Moderate	Moderate	Moderate
Foxtail Cactus *Escobaria vivipara var. alversonii*	C2	ND	List 1B R - 2 E - 2 D - 2	Occurs	Occurs	Occurs

Table 3-1 Special-Status Plants and Plant Communities Reported from the Region						Page 2 of 3
Common Name ***Scientific name***	**[1]Federal status**	**[1]State status**	**[2]CNPS status**	**[3]Probability of occurrence**		
				Landfill site	**Access roads**	**Rail line**
California Barrel Cactus *Ferocactus acanthodes* var. *acanthodes*	BLM	ND	ND	Occurs	Occurs	Occurs
Munz's Cholla *Opuntia munzii*	C2	ND	List 1B R - 3 E - 1 D - 3	Absent	Absent	Low
California Ditaxis *Ditaxis californica*	C2	ND	List 1B R - 3 E - 2 D - 3	Moderate	High **Occurs**	High
Salton Milkvetch *Astragalus crotalariae*	ND	ND	List 4 R - 1 E - 1 D - 3	Absent	Low (KR < 250m) **Absent**	Moderate **Low**
Sand-flat Locoweed *Astragalus insularis* var. *harwoodii*	ND	ND	List 2 R - 2 E - 2 D - 1	Absent	Low	Low
Borrego Milkvetch *Astragalus lentiginosus* var. *borreganus*	ND	ND	List 4 R - 1 E - 1 D - 1	Absent	Moderate (KR)	Moderate
Cove's Senna *Senna covesii*	ND	ND	List 2 R - 2 E - 2 D - 1	Low	Absent	Low
Orocopia Sage *Salvia greatae*	C2	ND	List 1B R - 2 E - 1 D - 3	Absent	Absent	Occurs

Table 3-1 Special-Status Plants and Plant Communities Reported from the Region						Page 3 of 3
Common Name ***Scientific name***	**[1]Federal status**	**[1]State status**	**[2]CNPS status**	**[3]Probability of occurrence**		
				Landfill site	**Access roads**	**Rail line**
Desert Unicorn Plant *Proboscidea althaeifolia*	ND	ND	List 4 R - 1 E - 1 D - 3	Moderate	Moderate	Occurs
Santa Ana Woolly-star *Eriastrum densifolium* ssp. *sanctorum*	FE	SE	List 1B R - 3 E - 3 D - 3	Absent	Absent	Absent
Slender-Horned Spineflower *Dodecahema [Centrostegia] leptoceras*	FE	SE	List 1B R - 3 E - 3 D - 3	Absent	Absent	Absent
Thurber's Pilostyles *Pilostyles thurberi*	C3C	ND	List 4 R - 1 E - 1 D - 1	Low	Low	Moderate
Las Animas Colubrina *Colubrina californica*	C3C	ND	List 4 R - 1 E - 1 D - 2	Moderate	Low **Occurs**	Moderate **Occurs**
Crucifixion Thorn *Castela emoryi*	ND	ND	List 2 R - 2 E - 1 D - 1	Moderate	Occurs (KR)	Occurs
Parish's Desert-thorn *Lycium parishii*	ND	ND	List 2 R - 2 E - 1 D - 1	Low	Low	Low

Appendix 4.0. Mapped locations of las animas colubrina and California ditaxis found in April-May 1996 along the proposed Eagle Mountain access road.

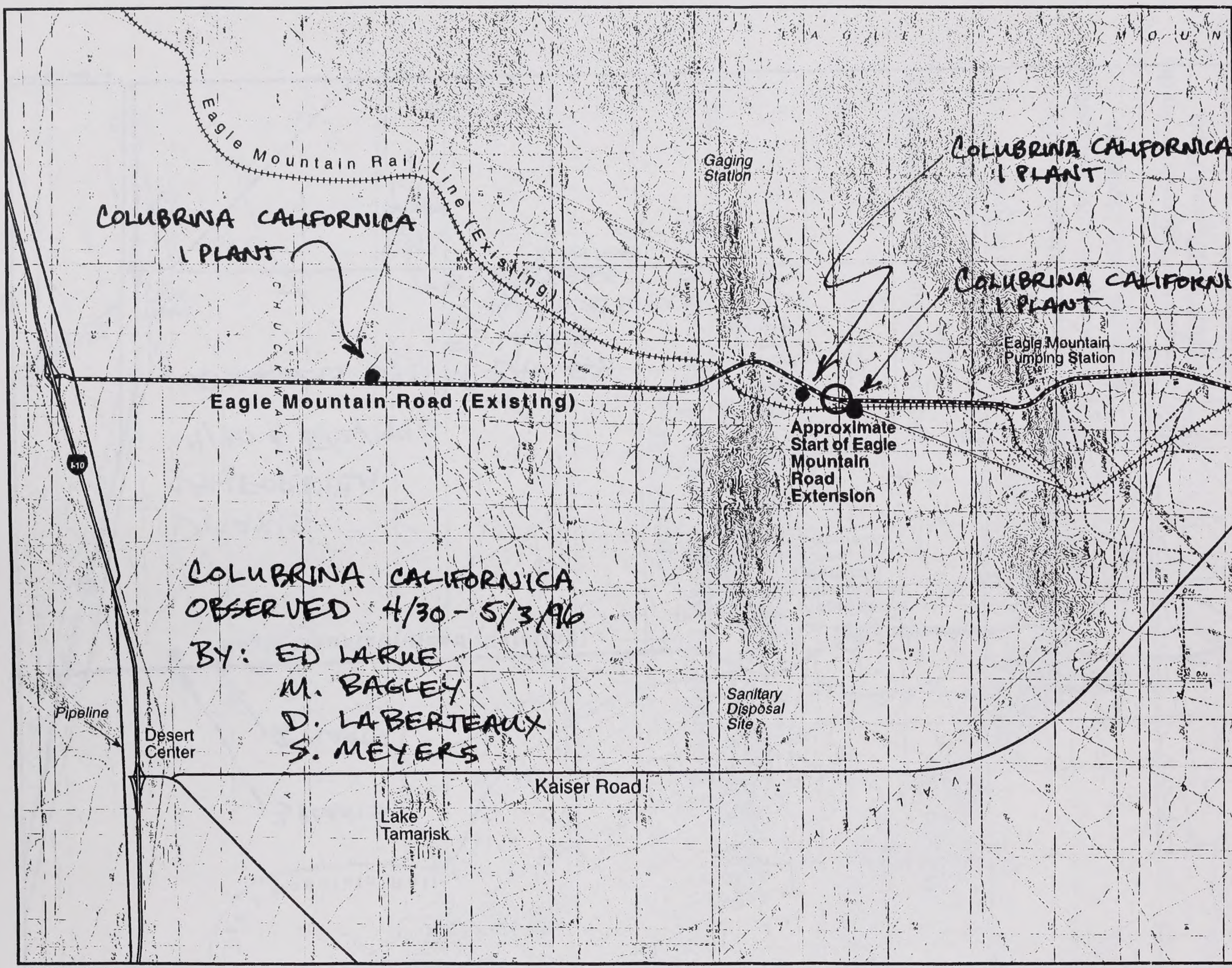

Figure _
Existing Eagle Mountain Road Alignment
Eagle Mountain Landfill and Recycling Center EIS/EIR

CH2M HILL

m115231.T6.20 rdalgn 8/95

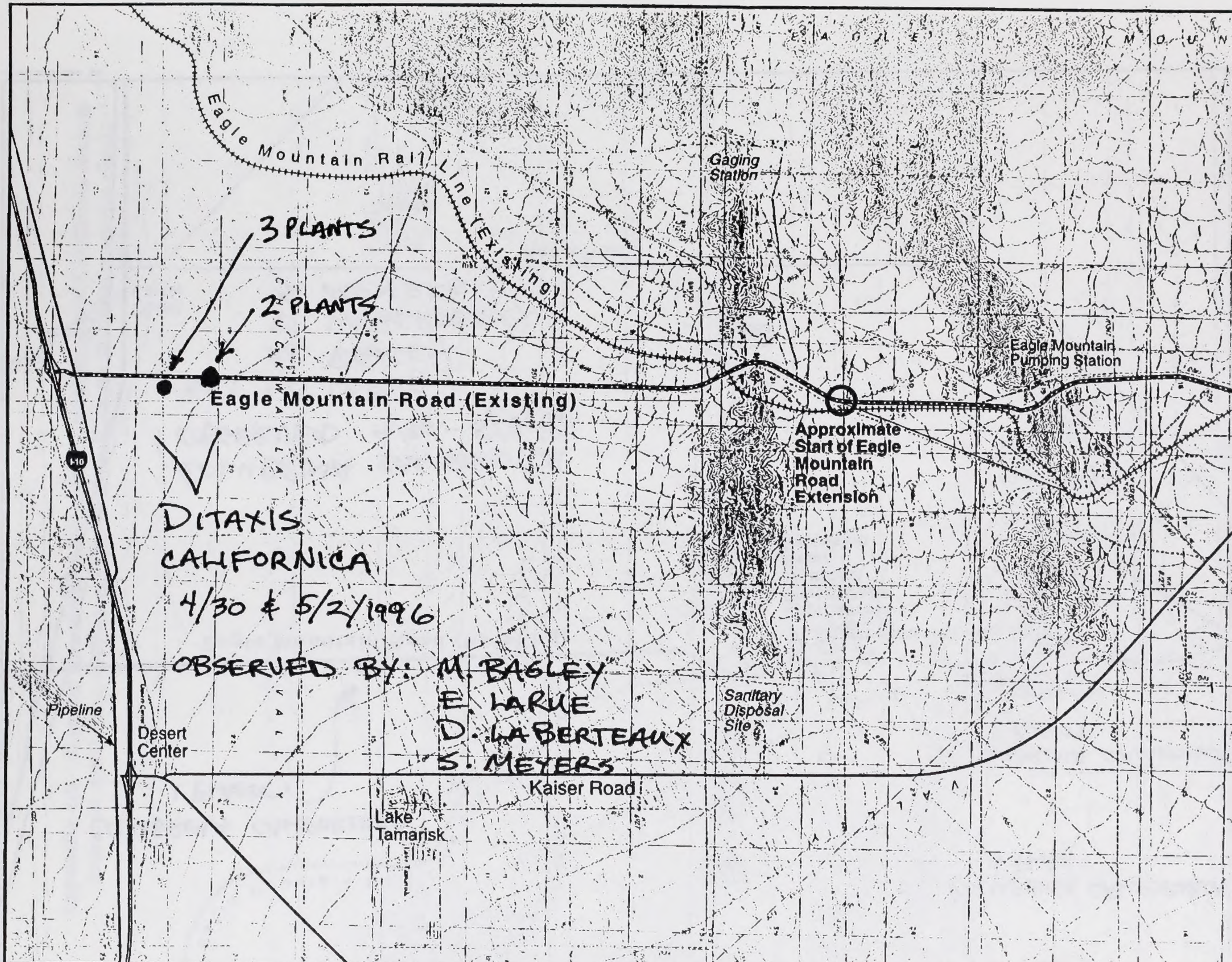

Figure _
Existing Eagle Mountain Road Alignment
Eagle Mountain Landfill and Recycling Center EIS/EIR

CH2M HILL

m115231.T6.20 rdalgn 9/95

Appendix H
Seismicity Case Studies and Related Data

Appendix H-1
Seismic Information Summary Report

Prepared for

Mine Reclamation Corporation
960 Tahquitz Canyon Way, Suite 204
Palm Springs, California 92262

SEISMIC INFORMATION SUMMARY REPORT

EAGLE MOUNTAIN LANDFILL AND RECYCLING CENTER RIVERSIDE COUNTY, CALIFORNIA

Prepared by

GeoSyntec Consultants
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Project Number GE3586-18

May 1996

EXECUTIVE SUMMARY

At the request of Mine Reclamation Corporation, GeoSyntec Consultants (GeoSyntec) has reviewed and summarized the results of extensive geologic characterizations, seismologic studies, and seismic analyses performed from 1989 through 1993 for the proposed Eagle Mountain Landfill and Recycling Center (Eagle Mountain Landfill) in northeastern Riverside County, California. The geologic and seismologic investigations and seismic hazard and performance analyses were performed by several firms and consultants, including GeoSyntec, GSi/water, Inc., Mr. Richard J. Proctor, R.G., C.E.G., Dr. Roy Shlemon, R.G., C.E.G., and Dr. Geoffrey R. Martin, P.E. The results of the investigations are reported in detail in the Report of Waste Discharge (ROWD) and Supplemental Volume 1 (ROWD SV-1).

The large-body of technical data and information developed in preparing the ROWD and ROWD SV-1 clearly demonstrates that the proposed Eagle Mountain Landfill exceeds the seismic design requirements mandated by State and Federal regulations and provides a high level of resistance against seismic upset. The geologic investigations described herein show that Holocene-age, as well as underlying Pleistocene-age, sediments at and in the vicinity of the site are unbroken by faults. The lack of Holocene faulting at the Eagle Mountain site is supported by geologic field mapping, trench logging, aerial photo-analysis, geomorphologic and soil stratigraphic age dating, potassium-argon geochronologic age dating, patterns of micro-seismicity in the project vicinity, and the general pattern of observed, documented Holocene faulting in California. Local and regional geological studies provide positive evidence that no Holocene-age faults exist at or in the vicinity of the site. The available data and information also indicate that the last episode of active faulting occurred in the site vicinity more than 100,000,000 years ago.

The detailed seismic hazard analysis for the landfill is also described in this report. Two alternative approaches were used to develop the design earthquake for the project: the prescriptive approach contained in Federal regulations and the alternative approach

contained in California regulations. Results of the seismic hazard analysis following the Federal approach indicate that the maximum expected horizontal acceleration in rock at the site with a 90 percent probability of not being exceeded in 250 years, the prescriptive Subtitle D design acceleration, is 0.56 g. This design acceleration may be attributed to a "random," non-fault specific earthquake associated with the Southeast Transverse Ranges seismo-tectonic zone or an earthquake as the nearby potentially-active Blue Cut fault. The inferred magnitude (M) of this design earthquake is 6.0 and 6.5, and it is assumed to occur at a distance of approximately 5 miles (8 km) from the site.

In the alternative approach to evaluating the design earthquake required by California regulations, a site-specific analysis was performed to establish the Maximum Probable Earthquake (MPE). For the alternative approach, two earthquake events were considered: (i) a near-field event in the range of a magnitude 6.0 to 6.5 from the Southeast Transverse Ranges source zone or Blue Cut Fault; and (ii) a far field event consisting of a magnitude 7.8 event due to the concurrent rupture of the Coachella Valley and San Bernardino Mountain segments of the San Andreas fault at a distance of 33 miles (53 km) from the site.

Several different categories of seismic slope-stability analysis were performed to confirm that the shear strength properties of the natural and engineered materials included in the landfill design, coupled with the proposed geometry of the landfill would produce adequate landfill seismic performance. The analyses included pseudo-static slope stability of natural and man-made slopes, and deformation analyses for the liner and cover systems of the landfill. For the deformation analyses, suites of representative time histories were assigned to both the prescriptive Subtitle D and alternative California design events. Landfill performance analyses were conducted using selected time histories to establish minimum acceptable interface shear strength values for inclusion in the landfill construction specifications. Calculated permanent displacement of the landfill for the design seismic event is less than 12 in. Engineered components of the landfill are designed to accommodate ground motions and the

calculated levels of permanent displacement without loss of serviceability and protection of the surrounding environment.

From the information presented in the ROWD, ROWD-SV1, and this report, it is concluded that the Eagle Mountain Landfill will be very resistant to seismic upset and secure for any earthquake that can reasonably be anticipated at the project site. The factors contributing to this conclusion are:

- the location of the landfill site beyond (to the east) the region of historical high seismicity in southern California;
- the absence of known active foulting at, or in the vicinity of, the project site;
- the conservative design approach taken for the Eagle Mountain landfill wherein the facility has been designed to satisfy both the prescriptive approach of the Subtitle D regulations and the alternative site-specific approach of California Chapter 15 regulations;
- the selection of conservative ground motion characteristics to associate with the design seismic events and conservative landfill and liner system material properties for use in seismic performance analyses;
- results of slope stability analyses including pseudostatic and deformation analyses demonstrating the landfill design and slope geometries perform satisfactory to the seismic loads;
- the liner and cover systems for the Eagle Mountain Landfill can withstand the design earthquakes without impairment to the indigrity of the landfill's containment systems.

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1. INTRODUCTION

1.1 Terms of Reference

At the request of Mine Reclamation Corporation (MRC), GeoSyntec Consultants (GeoSyntec) has reviewed and summarized the results of extensive geologic characterization, seismologic studies, and seismic analyses performed from 1989 through 1993 for the proposed Eagle Mountain Landfill and Recycling Center (Eagle Mountain Landfill) in northeastern Riverside County, California. The geologic and seismologic investigations and seismic hazard analyses were performed by several firms and consultants, including GSi/water, Inc., Mr. Richard J. Proctor, R.G., C.E.G., Dr. Roy Shlemon, R.G., C.E.G., Dr. Geoffrey R. Martin, P.E., and GeoSyntec. The seismic performance analyses were conducted by GeoSyntec, with input to the analyses from questions and comments formulated by regulatory agency staff during the review process.

This report was prepared by Dr. Jorge G. Zornberg and Dr. Edward Kavazanjian Jr., P.E., G.E., both of GeoSyntec. The report was reviewed by Dr. Rudolph Bonaparte, P.E., and Mr. Paul Guptill, C.E.G., of GeoSyntec in accordance with the internal review policy of the firm.

The available background information, site-specific studies, and seismic performance analyses include:

- field investigations and seismic analyses performed during preparation of the Report of Waste Discharge (ROWD), submitted to the California Regional Water Quality Control Board - Colorado River Basin, Region 7 (RWQCB) in December 1992 [GeoSyntec 1992];
- supplemental field investigations and seismic performance analyses performed during preparation of Supplemental Volume Number 1 of the ROWD

(ROWD-SV1), submitted to the RWQCB in June 1993 [GeoSyntec 1993a]; the supplemental field investigations and analyses were performed in response to questions and comments on the ROWD from the RWQCB, the State Water Resources Control Board (SWRCB), and the California Integrated Waste Management Board (CIWMB);

- supplemental slope stability analyses performed during preparation of a draft report presenting additional slope stability analyses [GeoSyntec 1993b]; this draft report was prepared to provide responses to comments presented by the California Department of Water Resources (DWR); and

- information presented in a summary report on the age of faulting prepared at the request of the RWQCB [GeoSyntec 1993c].

The results of the investigations are reported in detail in the above referenced ROWD and its supplemental volumes. The ROWD specifically addresses development of Phases 1, 2, 3, and 4 of the proposed landfill. The RWQCB issued Waste Discharge Requirements (WDRs) for Phases 1 through 4 of the Eagle Mountain Landfill on 17 May 1994. A ROWD for development of Phase 5 of the landfill is planned for a future date. It is noted, however, that the information developed during the 1989 to 1993 geologic, seismologic, and seismic investigations is applicable to Phase 5 of the Eagle Mountain Landfill project.

1.2 Objectives and Scope of the Report

The large body of technical data and information developed in preparing the ROWD and ROWD SV-1 clearly demonstrates that the proposed Eagle Mountain Landfill exceeds the seismic design requirements mandated by State and Federal regulations and provides a high level of resistance against seismic upset.

The specific purpose of this report is to summarize the large volume of information prepared for public and regulatory review during the state permitting process. To this effect, the report summarizes the geologic field characterizations, seismologic studies, and seismic stability analyses performed during preparation of the ROWD and ROWD-SV1.

Geologic investigations showing that Holocene-age, as well as underlying Pleistocene-age, sediments at and in the vicinity of the site are unbroken by faults is described herein. The lack of Holocene faulting at the Eagle Mountain site is supported by geologic field mapping, trench logging, aerial photo-analysis, geomorphologic and soil stratigraphic age dating, potassium-argon geochronologic age dating, patterns of micro-seismicity in the project vicinity, and the general pattern of observed, documented Holocene faulting in California. The detailed seismic hazard analysis for the landfill is also discussed in this report. Two alternative approaches to developing the design earthquake for the project considered in the seismic hazard assessment are described herein: the prescriptive approach contained in Federal regulations and the alternative approach contained in California regulations. The seismic site response and deformation analyses performed employing the results of the seismic hazard analyses are also presented herein. The results of the analyses indicate that the liner and cover systems for the Eagle Mountain landfill can withstand the design earthquakes without impairment to the integrity of the landfill's waste containment systems.

1.3 <u>Organization of this Report</u>

This summary report on seismic evaluations performed for the Eagle Mountain Landfill project is organized as indicated below.

- A general description of the regulatory framework that affects the seismic design for the Eagle Mountain Landfill, along with a brief explanation of how the

proposed development plan complies with the applicable seismic criteria, is presented in Section 2.

- Background information concerning the regional and local seismologic and geologic setting is described in Section 3.

- Site-specific studies concerning geologic mapping of the site, investigations demonstrating the lack of local Holocene faults, and detailed seismic hazard analyses are addressed in Section 4.

- The results of seismic slope stability analyses of the landfill performed during preparation of the ROWD are summarized in Section 5. These analyses include pseudo-static stability analyses of natural and man-made slopes as well as seismic response and deformation analyses of the proposed landfill liner and cover systems. Additional studies performed in response to DWR comments to the initial seismic performance analyses presented in the ROWD are also described in Section 5.

- Finally, a summary of the seismic evaluations performed for the proposed landfill as well as conclusions addressing compliance of the proposed landfill project with respect to State and Federal siting and seismic design are presented in Section 6.

2. REGULATORY FRAMEWORK

2.1 Introduction

The ROWD and ROWD-SV1 present information describing the siting, design, construction, operation, closure and post-closure maintenance of the proposed Eagle Mountain Landfill. These documents also provide demonstrations that the proposed landfill meets or exceeds both Federal and State regulations required for development of the facility. Included in both federal and state regulations are restrictions on siting of the facility with respect to the location of known Holocene faults and design criteria with respect to the ability of the landfill containment systems to withstand seismic shaking.

2.2 Federal Regulations

Federal regulations contain criteria on the siting of municipal solid waste landfills and on design of landfill containment systems to resist strong ground motions. These regulations are contained in Title 40, Section 258, of the Code of Federal Regulations, Subtitle D of the Resource Conservation and Recovery Act (hereafter referred to as Subtitle D).

Section 258.13 of Subtitle D states that *"New MSWLF units and lateral expansions shall not be located within 200 ft (60 m) of a fault that has had displacement in Holocene time ..."*. As will be discussed subsequently in this report, the geologic studies conducted at the Eagle Mountain Landfill project did not reveal the presence of any faults or shear zones at the landfill site, or within 200 ft of the site, that exhibited any evidence of displacement in Holocene time (the past 11,000 years).

Moreover, Section 258.14 of Subtitle D requires that *"New MSWLF units and lateral expansions shall be not located in seismic impact zones unless all containment*

structures including liners, leachate collection systems, and surface-water control systems, are designed to resist the maximum horizontal acceleration in lithified earth material for the site." USEPA defines the "*maximum horizontal acceleration in lithified earth material*" as either the acceleration with a 90 percent or greater probability that the acceleration in rock will not be exceeded in 250 years depicted on a seismic hazard map (herein referred to as the prescriptive Subtitle D seismic design criteria) or, alternatively, the maximum expected horizontal acceleration based on a site specific analysis (herein referred to as the alternative seismic design criteria). The prescriptive Subtitle D value for the maximum expected horizontal acceleration in lithified earth (MHA) is typically evaluated from Map Sheet MF-2120 published by the United States Geological Survey (USGS) [USEPA, 1993; 1995], commonly referred to as the "Algermissen" map. The most recent version of the Algermissen map [Algermissen et al., 1990], identified by USGS as a draft map, establishes the MHA at the project site as slightly less than 0.60 g. To investigate the validity of the MHA for the Eagle Mountain Landfill site from this draft map and to establish the magnitude of the design earthquake to associate with the MHA, a site-specific probabilistic seismic hazard evaluation of the maximum expected horizontal acceleration in lithified earth at the site was conducted using up-to-date geological and seismological information [Martin, 1992]. Results of this site-specific seismic hazard analysis indicate that the maximum expected horizontal acceleration in rock at the site with a 90 percent probability of not being exceeded in 250 years is 0.56 g. This prescriptive Subtitle D design acceleration is attributed to a "random," non-fault specific earthquake associated with the Southeast Transverse Ranges seismo-tectonic zone with a magnitude (M) between 6 and 6.5 at a distance of approximately 5 miles (8 km) from the point of energy release in the subsurface to the landfill site. It also accounts for the potential for a similar magnitude earthquake on the nearby potentially-active Blue Cut fault.

In the site-specific probabilistic seismic hazard analysis, the random seismicity associated with the Southeast Transverse Ranges seismo-tectonic zone was distributed uniformly across the zone. The Eagle Mountain Landfill site is on the eastern edge of the Southeast Transverse Ranges zone, where historical seismic activity is significantly

lower than the rest of the zone. Therefore, the results of the site-specific seismic hazard assessment are considered to provide a conservative assessment of the shaking intensity associated with the prescriptive Subtitle D design earthquake. Ground motion records from earthquakes in the range of magnitude 6.0 to 6.5, scaled to 0.56 g, were used in the seismic performance analyses conducted during preparation of the ROWD to calculate the permanent displacement of the proposed liner system at the Eagle Mountain Landfill during the prescriptive Subtitle D design earthquake event. The analyses indicated that the anticipated level of permanent landfill deformation under the design seismic event is acceptable.

Finally, Section 258.15 of Subtitle D states that *"Owners or operators of new MSWLF units, existing MSWLF units, and lateral expansions located in an unstable area must demonstrate that engineering measures have been incorporated into the MSWLF unit's design to ensure that the integrity of the structural components of the MSWLF unit will not be disrupted..."* Unstable area is defined as *"... a location that is susceptible to natural or human-induced events or forces capable of impairing the integrity of some or all of the landfill structural components..."* and are considered to include *"... poor foundation conditions, areas susceptible to mass movements, and Karst terrains."* While not specifically cited in the regulations, unstable areas are cited in the USEPA Solid Waste Disposal Facility Criteria Technical Manual [USEPA, 1993] as also including areas susceptible to earthquake-induced liquefaction. Ground reconnaissance, remote sensing imagery, geologic mapping, and engineering analyses of natural slopes indicate the area around the Eagle Mountain Landfill is very stable. These investigations show no sign of significant geologic change for at least 40,000 years, and probably more than 100,000 years, based on the age of alluvial deposits around the site.

2.3 <u>State Regulations</u>

State regulations on the siting of Class III (municipal solid waste) landfills and on design of the containment system to resist strong ground motions are found in Title 23 of the California Code of Regulations, Chapter 15, Article 9 (hereafter referred to as Chapter 15) as amended by State Water Resources Control Board Order No. 93-62 for implementation of Subtitle D. The plan for development of the Eagle Mountain Landfill meets the criteria in Chapter 15 concerning seismic design criteria.

Specifically, Chapter 15, Article 3, Section 2533.(d) states that *"New Class III landfills and expansions of existing Class II-2 landfills shall not be located on a known Holocene fault."* As stated in the previous section, geologic and seismologic studies conducted for the Eagle Mountain Landfill did not reveal the presence of any faults or shear zones at the project site that exhibited any evidence of displacement in Holocene time.

Moreover, Section 2533.(e) of Chapter 15, Article 3 indicates that *"New Class III and existing Class II-2 landfills may be located within areas of potential rapid geologic change if containment structures are designed, constructed, and maintained to preclude failure."* Ground reconnaissance, remote sensing imagery, geologic mapping, and seismic stability analyses of the natural slopes in the site indicate the area around the Eagle Mountain Landfill to be very stable. Investigations showed no sign of significant geologic change for at least 40,000 years, and probably more than 100,000 years, based on the age of alluvial deposits at the site.

Finally, Section 2547.(a) of Chapter 15, Article 4 states that *"Class III waste management units shall be designed to withstand the maximum probable earthquake without damage to the foundation or to the structures which control leachate, surface drainage, erosion, or gas."* The Maximum Probable Earthquake (MPE) is evaluated in accordance with California Department of Natural Resources Division of Mines and Geology (CDMG) guidelines on the basis of a deterministic, site-specific seismic hazard

analysis. The Eagle Mountain Landfill site is not located in an area of high historical seismicity. Nonetheless, the landfill may be subjected to earthquake ground motions during its active life or post-closure period. Based upon the results of the deterministic, site-specific seismic hazard analysis prescribed by State regulations, the landfill has been designed to withstand ground motions associated with the MPE from both the near-field Southeast Transverse Ranges seismic source zone and the far field San Andreas fault source zone. Calculated permanent displacements of the landfill containment systems for the MPE design seismic events are acceptable.

2.4 Comparison of State and Federal Design Criteria

Both State and Federal regulations require that municipal solid waste landfills be designed to resist damage due to relatively high intensity, low frequency (i.e., rare) earthquake events. Federal regulations provide the option of using either a peak horizontal ground acceleration from a seismic hazard map with a 90 percent probability of not being exceeded in 250 years or the maximum horizontal acceleration from a site-specific analysis. California regulations employ the site-specific analysis approach of Subtitle D, calling for use of a design earthquake from a site-specific analysis for the maximum earthquake expected in a 100-year period.

While the California regulations use a shorter exposure period than the prescriptive Subtitle D approach, 100 years versus 250 years, this may not necessarily result in a lower level of seismic resistance. The California regulations consider each active and potentially active fault individually, rather than aggregating them together into a single "hazard curve." Furthermore, the California regulations consider the maximum earthquake, usually interpreted to mean the most damaging earthquake, rather than the earthquake with the maximum horizontal acceleration. Therefore, California regulations account for the fact that large distant earthquakes may be more damaging than smaller, closer earthquakes associated with higher ground accelerations. Some of the greatest damage in recent earthquakes has been due to distant, large magnitude

earthquakes with relatively low ground accelerations (e.g., damage from the 1985 Mexico City and 1989 Loma Prieta (San Francisco) earthquakes). The site-specific analysis called for in the California regulations also allows for a higher degree of precision and significantly less uncertainty than the prescriptive Subtitle D approach that employs the maximum acceleration obtained from a seismic hazard map. Regardless of which approach is used, both provide for a high level of seismic resistance.

For the Eagle Mountain Landfill project, both the prescriptive Subtitle D and alternative California earthquake loading criteria were conservatively used for seismic design of the facility.

3. BACKGROUND INFORMATION

3.1 Location

The proposed Eagle Mountain Landfill site is located in a remote area of northeastern Riverside County in southern California, approximately 170 mi (322 km) east of Los Angeles, 60 mi (100 km) east of Palm Springs, and 50 mi (81 km) west of the Arizona border. The site's location within Riverside County is shown on Figure 1. As can be seen on the figure, the site lies approximately 8 and 10 mi (13 and 16 km) north, respectively, of the residential communities of Lake Tamarisk and Desert Center.

The project site occupies a plan area of about 4,684 acres (1,896 hectares), mostly within a portion of the inactive Eagle Mountain Iron Ore Mine property. The landfill portion of the project site will occupy a plan area of approximately 2,154 acres (871 hectares). The portion of the Eagle Mountains containing the site is bordered on the north by the Pinto Valley, on the east and southeast by the Chuckwalla Valley, and on the southwest and west by a continuation of the Eagle Mountains. Nonhazardous solid waste will be transported to the landfill, primarily by rail from transfer stations located in southern California and in lesser quantities by truck from local sources. At the ultimate design capacity of 20,000 tons (18,000 tonnes) of solid waste per day, the total available airspace for the first 4 phases of development of the landfill, equal to 670 million cubic yards (510 million cubic meters), will be filled up in 78 years.

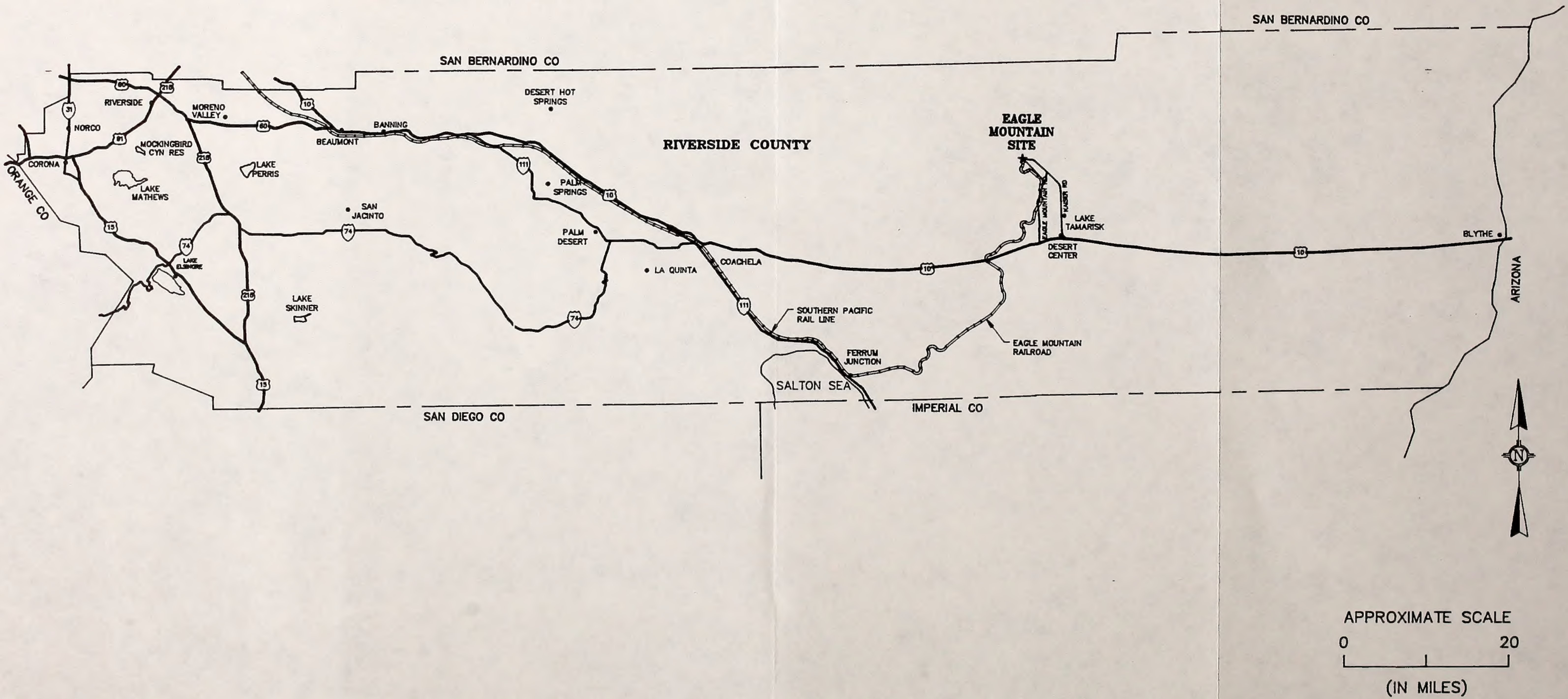
3.2 Regional Geologic Setting

The Eagle Mountains extend into the Basin and Range Geologic Province at the eastern extremity of the Southern California Transverse Ranges. The regional geology is shown on Figure 2. The mountains comprise Jurassic to Cretaceous age plutonic intrusive rocks emplaced in Paleozoic and Precambrian-age meta-sedimentary rocks. Iron minerals are found between quartzite units of the meta-sedimentary rocks as

magnetite and hematite. The iron minerals were formed by the replacement of carbonate meta-sedimentary rocks that had been previously subjected to hydrothermal alteration. Meta-sedimentary rocks in the Eagle Mountains form a northwest-trending roof pendant within the intrusive rocks. The roof pendant is approximately in line with similar age formations in other mountain ranges northwest and southeast of the Eagle Mountains. The roof pendant has been folded into a northwest trending anticline that extends across the north central Eagle Mountains. Major ore bodies are located along the north limb of this anticline.

East-trending faults are present along the northern edge of the Eagle Mountains, about 5 miles (8 km) north of the proposed Eagle Mountain Landfill site. East-trending faults are also present in the Eagle Mountains about 5 miles (8 km) south of the landfill site. Non-Holocene-age faults have been observed within the property boundaries of the inactive Eagle Mountain Iron Mine site. These faults trend southeasterly, contrary to the east-west trend of active and potentially active faults within the Transverse Ranges seismotectonic province. Local faulting at the proposed landfill site has been extensively investigated by Proctor [1993], Shlemon [1993], and GSi/water [in GeoSyntec, 1993a] and found not to be active. These investigations are described in Section 4 of this report.

Northeast-trending dikes occur within the granitic plutonic rocks north and south of Eagle Creek in the vicinity of the proposed landfill footprint. The dikes are sub-parallel to each other, occurring at approximately right angles to the northwest trending faults. Extensive potassium-argon (K-Ar) age-dating of the intrusive rocks that comprise the dikes that intersect the faults was performed, providing strong evidence that their occurrence post dates faulting in the area [GeoSyntec, 1993a]. The dikes have nearly vertical dips and are probably the result of igneous intrusion along tension fractures associated with ancient volcanism and regional tectonic stresses.



EAGLE MOUNTAIN

LANDFILL AND RECYCLING CENTER

RIVERSIDE COUNTY, CALIFORNIA

PREPARED FOR:

MINE RECLAMATION CORPORATION

SITE VICINITY MAP

GEOSYNTEC CONSULTANTS

HUNTINGTON BEACH, CALIFORNIA

PROJECT NO.:	CE4030-02
DOCUMENT NO.:	MRC-065
FIGURE NO.:	1

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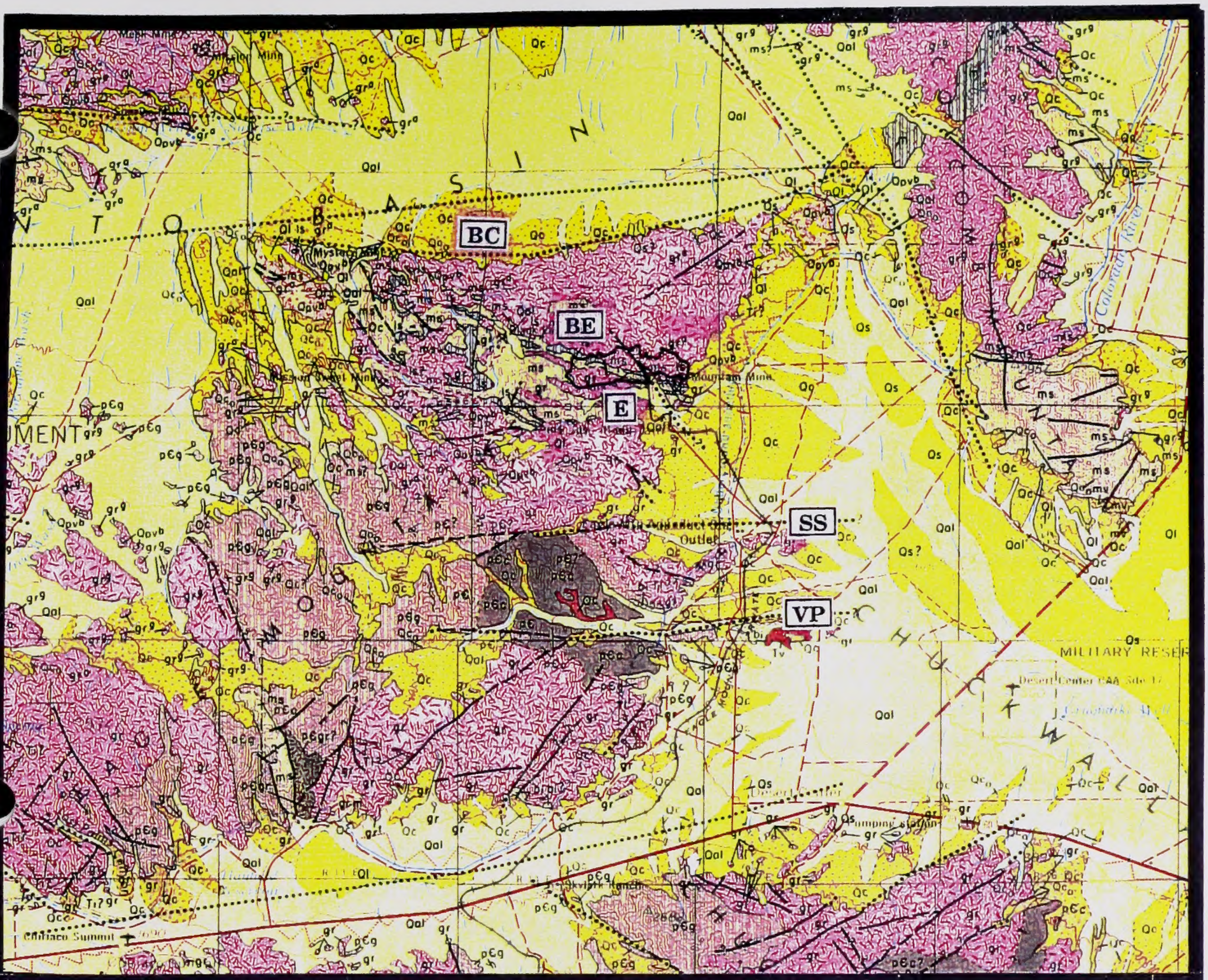


Explanation

SEDIMENTARY AND METASEDIMENTARY ROCKS

- Qs — Dune sand
- Qal — Alluvium
- Ql — Quaternary lake deposits
- Qc — Pleistocene nonmarine
- Pre-Cretaceous metamorphic rocks
- ms — Pre-Cretaceous metasedimentary rocks
- pЄ — Undivided Precambrian metamorphic rocks

IGNEOUS AND META-IGNEOUS ROCKS

- Qpv — Pleistocene volcanic rocks
- Tertiary intrusive rocks
- Tertiary volcanic rocks
- gr — Mesozoic granitic rocks
- pCc — Precambrian igneous and metamorphic rock complex
- pЄg — Undivided Precambrian granitic rocks

- BC — Blue Cut fault
- BE — Bald Eagle Canyon fault
- SS — Substation fault
- VP — Victory Pass fault
- Fault: solid where known, dashed where inferred, dotted where concealed
- E — Proposed landfill site

Source: C.D.M.G. Geologic Map of California Salton Sea Sheet, 1967

N

0 — 5 miles

Scale

EAGLE MOUNTAIN

LANDFILL AND RECYCLING CENTER
RIVERSIDE COUNTY, CALIFORNIA
PREPARED FOR:
MINE RECLAMATION CORPORATION

REGIONAL GEOLOGY

GSi/water
(Geothermal Surveys, Inc.)

PROJECT NO. : 107 (CE 4030)
DOCUMENT NO. : MRC-065
FIGURE NO. : 2

Range-border faulting (i.e, tension faulting at a boundary between a valley and mountain range) occurs along the eastern side of the Chuckwalla Valley parallel to the base of the Coxcomb Mountains. This faulting may vertically displace bedrock beneath the valley nearly 0.6 miles (1 km) downward along the eastern side of the valley. However, no range-border faults are apparent along the eastern side of the Eagle Mountains.

The Pinto Basin and Chuckwalla Valley are Quaternary alluvium filled valleys. Quaternary alluvium and areas of Quaternary conglomerate extend basinward in wide zones along basin/mountain contacts. The alluvium extends from the floors of canyons within the proposed Eagle Mountain Landfill property in a thickening wedge into the down-drainage area of the Chuckwalla Valley east and southeast of the site. These alluvial deposits underlie the Chuckwalla Valley.

The alluvium is Quaternary in age and extends basinward in wide zones along basin/mountain contacts. At a distance of 3 miles (5 km) from the eastern range-front of the Eagle Mountains, the alluvial fill reaches depths greater than 1,200 ft (360 m). Lithologically, the alluvium consists largely of gravel, gravelly sand, sand, clayey sand, and clay with the finer-grained clastics and clay content increasing generally basinward with distance from the mountain-range sources.

3.3 Local Geology

3.3.1 Bedrock

Bedrock within the project area consists of Paleozoic meta-sedimentary rocks and Mesozoic igneous intrusive rocks. The meta-sedimentary rocks consist of former sandstone and conglomerate, arkose, and carbonate rock that were folded, faulted, metamorphosed, and hydrothermally altered to quartzite, meta-arkose, and marble, respectively. Igneous rocks include sills, dikes, and irregular bodies of porphyritic

quartz monzonite, diorite, monzonite porphyry, granodiorite, and granite. The meta-sedimentary rocks form a northwest-trending roof pendant within the igneous intrusive rocks. The iron ore zone at the site has an abundant presence of the minerals magnetite and hematite that have resulted from hydrothermal alteration of mostly carbonate meta-sedimentary rocks (i.e., dolomitic marble).

From older to younger, the lithologic units that comprise the bedrock at the proposed landfill site include: (i) *lower quartzite*, 1,000 ft (300 m) or more thick; (ii) *schistose meta-arkose*, 20 to 200 ft (6 to 60 m) thick; (iii) *lower marble*, 20 to 200 ft (6 to 60 m) thick; (iv) *middle quartzite*, 150 to 400 ft (45 to 120 m) thick; (v) *upper marble*, 50 to 400 ft (15 to 120 m) thick; (vi) *upper quartzite*, several hundred feet thick; (vii) *granitic rocks* comprising mostly quartz monzonite, monzonite porphyry, and granodiorite; (viii) *dikes*, which appear in two types of systems, one mafic and oriented northwest-southeast, and the other andesitic, consisting of dikes composed of andesite and andesite porphyry oriented northeast-southwest; and (ix) *ore body* consisting mainly of hematite and magnetite, formed by hydrothermal replacement.

The ore body in the vicinity of the site was formed by replacement of meta-sedimentary rocks between two of the major metasedimentary units (i.e., the *lower quartzite* and *upper quartzite* lithologic units) and by replacement of porphyritic quartz monzonite. Hydrothermal alteration preceded ore deposition [DuBois, 1958].

3.3.2 Surficial Deposits

Unconsolidated deposits within the project area overlie the bedrock and consist of alluvial sands, silts, gravels, and debris-flow material laid down as channel and flood plain deposits. Mining by-products in the area are identified as those materials consisting of tailings and overburden from the former mining operations at the site.

Within the property boundaries of the landfill site, comparatively thin alluvial deposits of limited lateral extent occur in the narrow canyon bottoms. The alluvium thickens more or less continuously from the range-front eastward toward, and into, the Chuckwalla Valley. In the northern Chuckwalla Valley, the alluvial deposits are a few tens of feet thick along the western margin of the valley. The deposits range in thickness to more than 2,000 ft (600 m) in the eastern part of the valley. The older units near the site may correlate with the deeper sediments in Chuckwalla Valley. The alluvial deposits that cover bedrock on canyon floors within the landfill footprint thicken from zero, in the headward ends of the canyon, southeastward on the order of 50 ft (15 m) at the canyon outlets. These thicknesses were obtained from the results of seismic refraction surveys conducted by GSi/water [in GeoSyntec, 1992]. From results of a soil testing program, the alluvial deposits in the canyons may be classified using the Unified Soil Classification System (USCS) as sandy gravel (GW) with varying percentages of cobbles and boulders that, in some areas, dominate the soil matrix.

Debris flows are sedimentary deposits, formed as a heterogeneous mixture of fine and coarse particles, that move downslope as a slurry. Debris flows are able to transport rocks, including large boulders, more efficiently than flowing water. The alluvial deposits contain debris flows throughout a large area east and southeast of the East Pit. A thick sequence of debris flow material resting directly on bedrock is exposed in the walls of the East Pit [GSi/water, 1991].

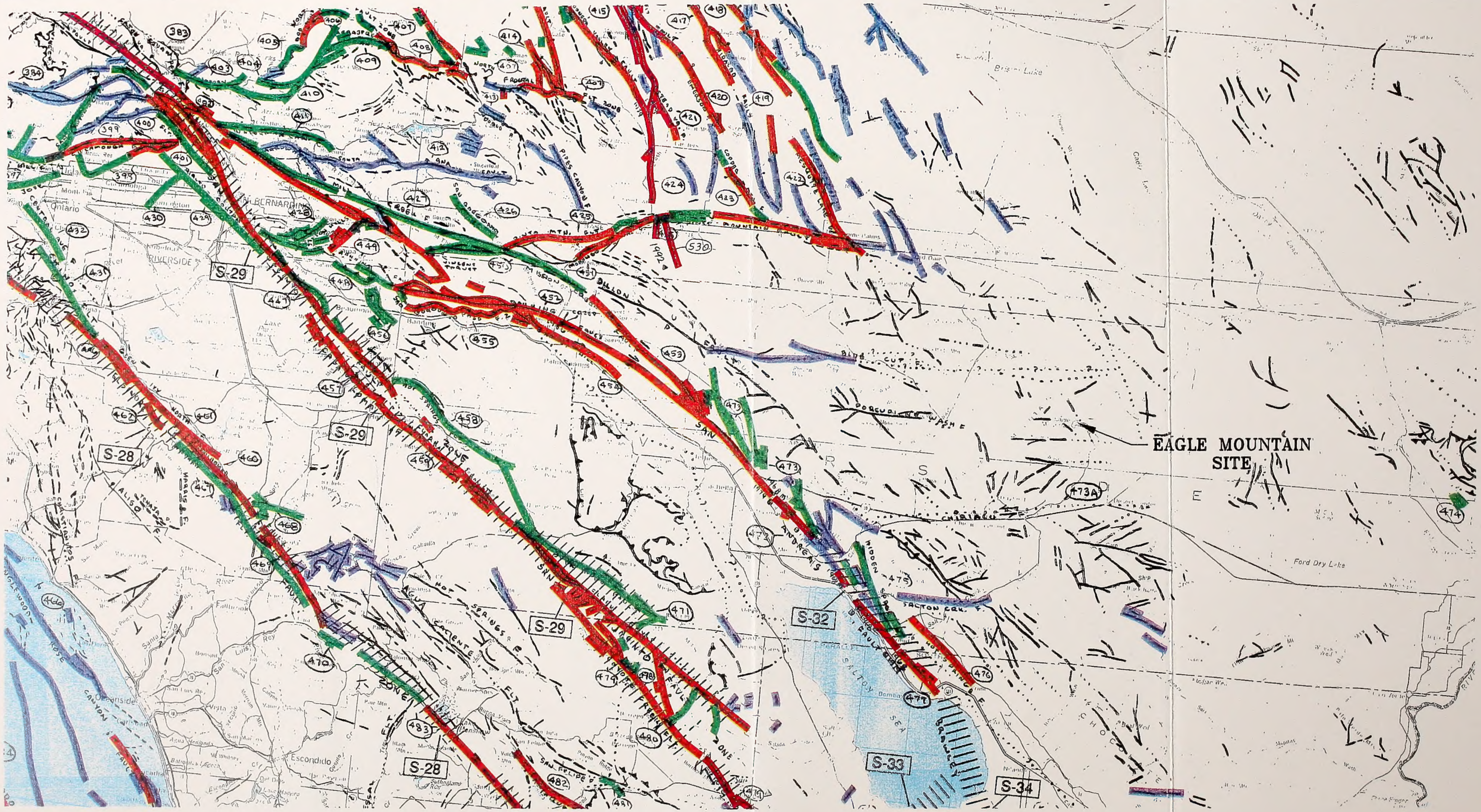
Mining by-product piles contain tailings and overburden materials generated from former mining operations. Overburden material have been deposited throughout the proposed landfill site. Tailings materials can be differentiated as fine and coarse. Fine tailings are located in several former sedimentation ponds southeast of the proposed landfill site. Coarse tailings are primarily deposited in a large pile south of the East Pit.

3.4 Seismicity

3.4.1 Regional Faults

In general, faults may be described as active, potentially active, or inactive based upon recency of movement. Seismicity may be described as fault specific and non-fault specific, depending upon whether it is associated with a recognized fault or is random seismicity associated with general area sources based upon seismo-tectonic zonation. Active faults are defined as faults along which seismically-induced (tectonic) displacement has occurred in the past 11,000 years, in the Holocene epoch [Jennings, 1994]. Potentially active faults are defined as faults along which tectonic displacement has occurred between 11,000 and 1.6 million years before present (ybp), before Holocene time but after the start of the Quaternary period [Jennings, 1994]. The term "inactive" is usually defined in regulatory requirements according to an adopted level of risk deemed acceptable to the governing agency. The level of risk is based on the time duration during which a fault has not experienced surface displacement due to faulting. Under landfill regulations, no definition of "inactive" exists. Instead, siting of new landfills and expansions must avoid Holocene-age (past 11,000 years) faults to satisfy the applicable Federal and State siting criteria (Section 258.13 of Subtitle D and Chapter 15, Article 3, Section 2533(d)). For the Eagle Mountain Landfill project, inactive faults have been defined as faults along which tectonic displacement has not occurred in the past 1.6 million years, since the start of the Quaternary period. This definition is adopted simply to differentiate active and potentially-active faults from those faults with no evidence of activity near the site.

Lack of displacement in the past 1.6 million years is a commonly used criterion for defining fault inactivity in California because the geologic community believes that between 750,000 and 1.6 million ybp, the tectonic environment in the southern California structural basins changed from one of general extension (i.e., stretching, or opening, of the basins) to compression (i.e., closing of the basins) [Wright, 1991].



SCALE 1:750,000

(1 INCH EQUALS APPROXIMATELY 12 MILES)

10 0 10 20 30 40 50 Miles

10 0 10 20 30 40 50 60 Kilometers

SOURCE: "PRELIMINARY FAULT ACTIVITY MAP OF CALIFORNIA", CDMG, [1992].

EAGLE MOUNTAIN

SEE FIGURE No. 3b FOR LEGEND

LANDFILL AND RECYCLING CENTER RIVERSIDE COUNTY, CALIFORNIA PREPARED FOR: MINE RECLAMATION CORPORATION	GEOSYNTEC CONSULTANTS HUNTINGTON BEACH, CALIFORNIA
FAULT MAP	PROJECT NO.: CE4030-02 DOCUMENT NO.: MRC-065 FIGURE NO.: 3a

4030E068 199212021055

Geologic Time Scale			Years Before Present (Approx.)	Fault Symbol	Recency of Movement	DESCRIPTION: ON LAND	DESCRIPTION: OFFSHORE
Quaternary	Late Quaternary	Historic	200			Displacement during historic time (e.g. San Andreas fault 1906). Includes areas of known fault creep.	
		Holocene	10,000			Displacement during Holocene time.	Fault offsets seafloor sediments or strata of Holocene age.
		Pleistocene	700,000			Faults showing evidence of displacement during late Quaternary time.	Fault cuts strata of late Pleistocene or older Quaternary age.
						Mesozoic Foothills fault system along which short segments of late Cenozoic faulting has taken place.	
	Early Quaternary		1,600,000			Undivided Quaternary faults – most faults in this category show evidence of displacement during the last 1,600,000 years; possible exceptions are faults which displace rocks of undifferentiated Plio-Pleistocene age.	
Pre-Quaternary			4.5 billion (Age of earth)			Faults without recognized Quaternary displacement or showing evidence of no displacement during Quaternary time. Not necessarily inactive.	Fault cuts strata of Pliocene or older age.

ADDITIONAL FAULT SYMBOLS

U = Upthrown side (relative or apparent)
D = Downthrown side (relative or apparent)

Bar and ball on downthrown side (used where space is limited)

Arrows along fault indicate relative or apparent direction of lateral movement.

Arrow on fault indicates direction of dip

Low angle fault (barbs on upper plate). Fault surface generally dips less that 45° but locally may have been subsequently steepened. On offshore faults, barbs simply indicate a reverse fault regardless of steepness of dip.

OTHER SYMBOLS

204 Numbers refer to annotations listed in the Appendices of the accompanying report. Annotations include fault name, age of fault movement, and pertinent references including Special Studies Zone maps where a fault has been zoned by the Alquist-Priolo Special Studies Zone Act of 1972 (amended 1974 and 1975). This Act requires the State Geologist to delineate zones to encompass all potentially and recently active faults.

Fault segment associated with a significant linear trend of accurately located earthquake epicenters (magnitude 4.2 or greater). Generally aligned along strike slip faults having Quaternary displacement, but not necessarily with historic surface rupture. Lack of seismic activity along any fault is no indication that the fault may not be active in the future (e.g. San Andreas fault north of San Francisco). Epicenter data are derived from closely spaced seismic stations and include either continuing microseismicity or aftershocks associated with relatively large earthquakes.

S-8 Aligned seismicity on fault segments are referenced in Appendices D and E.

SOURCE: "PRELIMINARY FAULT ACTIVITY MAP OF CALIFORNIA", CDMG, [1992].

EAGLE MOUNTAIN
LANDFILL AND RECYCLING CENTER
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GEOSYNTEC CONSULTANTS
HUNTINGTON BEACH, CALIFORNIA

FAULT MAP LEGEND

PROJECT NO.:	CE4030–02
DOCUMENT NO.:	MRC–065
FIGURE NO.:	3b

SEE FIGURE No. 4a FOR MAP

4030E069 199212031000

Thus, faults that have not moved in the past 1.6 million years are considered incapable of generating fault displacement or strong shaking in the current tectonic stress regime.

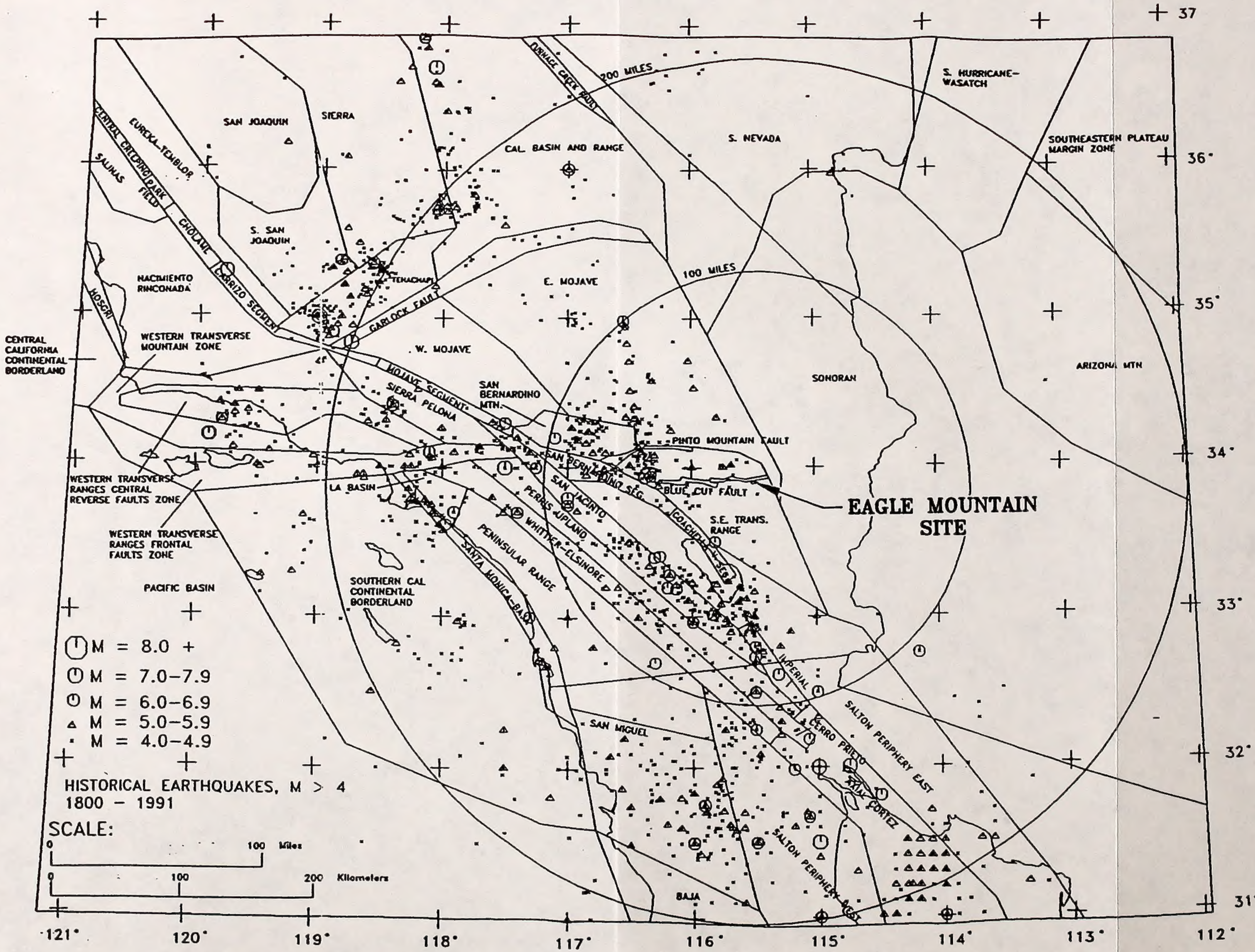
While all earthquakes are believed to be associated with displacement along faults, not all faults have surface expressions. This is particularly true of small magnitude earthquakes (i.e., events of magnitude less than 5.5), which may not generate surface displacement even if they are associated with a fault with a surface expression. The seismicity assessment performed for the Eagle Mountain Landfill includes non-fault specific area sources to account for seismic events which are not associated with surface faults. These area sources correspond to geologically defined seismo-tectonic provinces and are assigned seismicity rates based upon the historical seismicity record and the regional seismic creep (deformation) rate.

There are numerous active and potentially-active faults and fault zones located within 100 miles (160 km) of the site. Information on active, potentially-active, and inactive faults in the project vicinity, as compiled by CDMG [Jennings, 1994], is shown in Figure 3a. A legend for Figure 3a is provided on Figure 3b. The southern segment of the San Andreas fault, located approximately 33 miles (53 km) west of the site, is the only fault within 53 miles (85 km) of the site that has been zoned active under the Alquist-Priolo Special Studies Zone Act (Article 3, Subchapter 1, Chapter 8, Division 2, Title 14 of the California Administrative Code, (the "Act")). The Act was intended to identify active faults in the State of California that may be hazardous, in terms of surface-rupture potential, to buildings built adjacent to such faults. However, not all faults recognized as seismically active have as yet been zoned under the Act, and potentially-active faults must also be considered in the seismic hazard assessment as they may simply represent either faults with a recurrence interval greater than 11,000 years or faults without sufficient data to be classified.

In addition to the San Andreas fault, nearby active and potentially-active faults considered capable of generating significant seismic events that contribute to the potential for strong shaking at the Eagle Mountain site include the Blue Cut fault,

located at a map distance of about 4 miles (6 km) north of the site, and the Pinto Mountain fault, located 28 miles (45 km) northwest of the site. In addition to these fault-specific sources, non-specific area sources that should be considered in the evaluation of seismicity at the project site include the Southeast Transverse Ranges, the San Bernardino Mountains, the Eastern Mojave, the Sonoran, and the Salton seismotectonic zones. Table 1 identifies the faults and non-specific source zones considered in the seismic assessment for the Eagle Mountain Landfill. Note that small potentially-active and inactive local faults, including the Substation and Victory Pass faults, are included in the Southeast Transverse Ranges regional source zone in Table 1.

Figures 3a and 3b indicate that the project site is beyond the eastern limit of Quaternary fault activity in the Southeast Transverse Ranges physiographic province. The same conclusion may be drawn from Figure 4 taken from Martin [1992], which is a plot of earthquakes of magnitude 4.0 or greater recorded in the vicinity of the site since 1932. This figure also shows the project site to be east of the areas of significant seismic activity in southern California. Site-specific studies, discussed subsequently, substantiate this conclusion. The project site is generally bounded by two series of faults that trend east-west and northwest-southeast, respectively. The east-west trending faults that bound the site on the north and south are shown in Figure 3. The SE-NW trending faults are categorized by CDMG as inactive [Jennings, 1994]. The east-west trending faults, which include the Blue Cut, Substation, and the Victory Pass faults, neither transect the site nor pass within 3 miles (5 km) of the site. The site-specific studies discussed in Section 4 of this report, indicate that surface displacement has not occurred on the local SE-NW trending faults for at least 40,000 years and probably more 100,000 years.



EAGLE MOUNTAIN

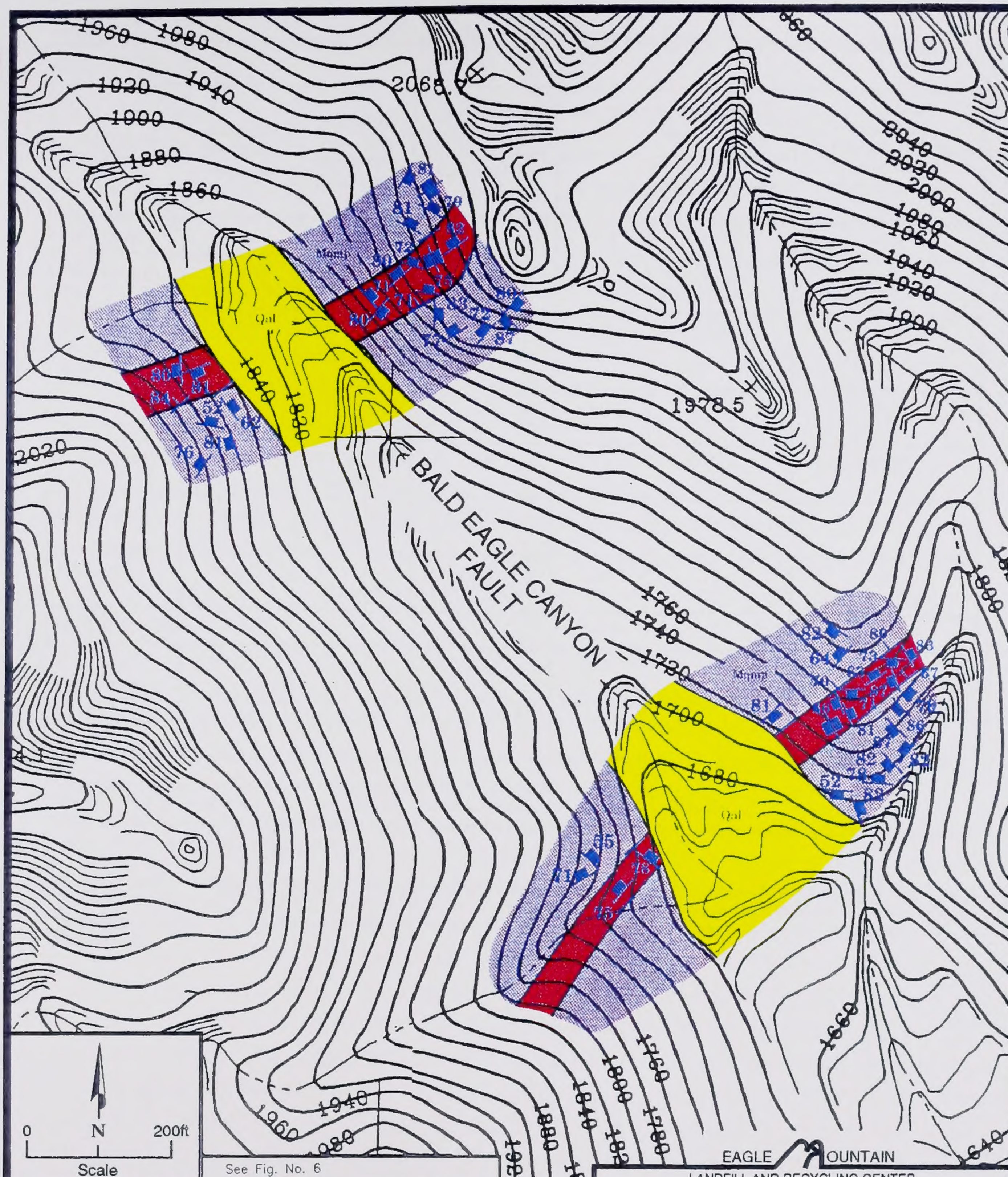
LANDFILL AND RECYCLING CENTER
RIVERSIDE COUNTY, CALIFORNIA
PREPARED FOR:
MINE RECLAMATION CORPORATION

SOUTHERN CALIFORNIA SEISMIC ZONES AND HISTORICAL SEISMICITY

GEOSYNTEC CONSULTANTS
HUNTINGTON BEACH, CALIFORNIA

FIGURE NO.	4
PROJECT NO.	CE4030-02
DATE:	MAY-13-96

SOURCE: GeoSyntec (1992), REPORT OF WASTE DISCHARGE, EAGLE MOUNTAIN LANDFILL AND RECYCLING CENTER, APPENDIX D, MARTIN (1992)



Explanation

Qal	Alluvium *		Geologic contact
Mgmp	Granitic rocks *	17	Strike and dip of fracture
	Quartz Latite dike		Vertical fracture
		52	Strike and dip of lithologic contact

(* See Plate 1 ROWD for detailed descriptions)

Base map from Cooper Aerial Survey Co.

EAGLE MOUNTAIN

LANDFILL AND RECYCLING CENTER
RIVERSIDE COUNTY, CALIFORNIA
PREPARED FOR:
MINE RECLAMATION CORPORATION

DETAILED GEOLOGY
BALD EAGLE CANYON FAULT

GSi/water (Geothermal Surveys, Inc.)	DATE : 6/1/93	MAPPED : 5/93
	DESIGN BY : THH	JOB NO. : 107 (CE 4030)
	DRAWN BY : DWB	FILE NO. : N/A
	CHECKED BY : THH	DOCUMENT NO. : MRC-065
	REVIEWED BY : RAS (PROJ. MGR)	FIGURE No. 7
	APPROVED BY : JHB (PRINCIPAL)	

Table 1. Significant Seismic Sources within 100 km of the Eagle Mountain Landfill Site

FAULT OR FAULT ZONE	CLOSEST DISTANCE, miles (km)	LENGTH miles (km) OR AREA[4] $miles^2$ (km^2)	MAXIMUM CREDIBLE EARTHQUAKE[5] MAGNITUDE (M max)	RECURRENCE INTERVAL, years $M \geq 4.5$	RECURRENCE INTERVAL, years $M \geq (M_{max} - 0.5)$	MAXIMUM CREDIBLE EARTHQUAKE PEAK HORIZONTAL ACCELERATION[1] g's
Blue Cut Fault	4 (6)	L - 52 (83)	7.5	39.5	12,500	0.48
Pinto Mountain Fault	28 (45)	L - 50 (80)	7.2	7.2	2,290	0.10
Southeast Transverse Ranges Zone	3 (5)[2]	A - 2,602 (6,737)	6.75	2.3	166	0.49
San Bernardino Mountains Zone	56 (90)	A - 832 (2,156)	7.0	6.2	778	0.03
Eastern Mojave Zone	7 (11)	A - 8,500 (22,008)	7.5	1.9	573	0.41
Sonoran Zone	14 (22)	A - 44,608 (115,487)	6.5	44.7	1,412	0.15
Salton Zone	34 (55)	A - 12,464 (32,269)	7.0	1.2	73.6	0.07
San Andreas Fault:[3]						
- Coachella Valley Segment	33 (53)	L - 27 (69)	8.0	69.5	695	0.14
-San Bernardino Segment	40 (65)	L - 48 (125)	8.0	0.8	795	0.11

[1]Using mean attenuation relationship of Sadigh as reported by Joyner and Boore [1988, 1992].

[2]Site is within S.E. Transverse Range. Minimum site to source distance assumed to be five kilometers.

[3]Minimum magnitude equal to 6.5 for Coachella Valley Segment. Maximum 8.0 magnitude event assumes simultaneous rupture of Coachella Valley, San Bernardino, and Mojave Segments.

[4]L = length and A = area.

[5]Maximum Credible Earthquake (MCE) is the *"maximum earthquake that appears capable of occurring under the presently known tectonic framework"* [CDMG, 1975]. The MCE represents a seismic event more severe than the Maximum Probable Earthquake (evaluation of which is required by Chapter 15). The MCE is presented in this table as a means of indicating the relative differences in fault source characteristics.

3.4.2 Regional Seismicity

3.4.2.1 Historical Seismicity

Figure 4 is a plot of all known historical earthquakes of magnitude greater than 4.0 within a 200 mile (320 km) radius of the site for the period from 1800 to 1991. This figure also shows the major faults, fault zones, and seismo-tectonic source zones. The data shown in Figure 4 are only considered complete for the past 60 years, since establishment in 1932 of the Southern California Seismic Network jointly administered by the United States Geological Survey and California Institute of Technology. Epicentral locations of events recorded in this period may be considered accurate to within a few kilometers [Given et al., 1987]. Prior to 1932, only events large enough and close enough to be felt in populated areas are known, and locations of these events are inferred based upon either observations of surface rupture or reports of observations of shaking intensity.

Figure 4 shows the site to lie within the Southeast Transverse Ranges (STR) seismo-tectonic zone on the eastern edge of the region of high historical seismicity in southern California. Furthermore, the site is south and east of the zones of highest historical seismic activity within the Southeast Transverse Ranges. Most seismicity within the Southeast Transverse Ranges province is associated with the San Andreas Fault Zone in the northwest corner of the zone. Much of the remaining seismicity within the zone is concentrated between the Blue Cut and Pinto Mountain faults to the north of the site. The closest recorded seismic event to the site on the historical record is an event of magnitude 4.0 to 4.9 approximately 5 miles (8 km) south of the site. The closest historical events of greater than magnitude 5 were two events of between magnitude 5.0 and 5.9 approximately 13 miles (21 km) northwest of the site, in the region between the Blue Cut and Pinto Mountain faults. The closest historical event of greater than magnitude 6.0 is approximately 50 miles (80 km) west of the site and appears to be associated with the San Andreas Fault Zone. Based upon these magnitudes and distances, and using the attenuation relationship developed by Sadigh

as reported by Joyner and Boore [1988, 1992] for rock sites in southern California, strongest ground motion (in terms of peak ground accelerations) at the site from events in the historical record would be estimated as 0.15 g using mean attenuation rates, and 0.27 g using mean plus one standard deviation attenuation rates.

3.4.2.2 Potential Seismic Sources

The closest potential seismic sources to the Eagle Mountain Landfill are the Blue Cut fault and a potential random source within the Southeast Transverse Ranges seismotectonic zone. More distant sources also exist, but due to the greater distances from the Eagle Mountain Landfill, only the Maximum Credible Earthquake (MCE) on the San Andreas fault has a potential for being more damaging than potential seismic events associated with the Blue Cut fault and random STR source. The rationale for selecting the potential earthquake magnitude and frequency of occurrence for use in the Eagle Mountain Landfill seismic hazard assessment is described for each source below.

The Blue Cut fault is a mappable geologic structure within the STR and is treated as a specific seismic source for the seismic hazard assessment. Although no Holocene (past 11,000 years) activity has been documented along the trace of the Blue Cut fault, Late Pleistocene earthquake surface faulting is evident as scarps in Pleistocene-age alluvial fan deposits (ROWD, Volume 5, Appendix D-3). The maximum magnitude of 7.5 assigned to the Blue Cut fault is conservatively based on total fault length and analogy with similar geologic features (e.g., Pinto Mountain fault) and historical seismicity (e.g., the Landers earthquake). The total length of the Blue Cut fault includes all en echelon faults along the zone from the Dillon fault on the west to Chuckawalla Valley at the east. In considering the maximum rupture length to estimate maximum earthquake magnitude, simultaneous ruptures of en echelon segments similar to the behavior observed along the Landers earthquake (M_w 7.5, where M_w is defined

as the moment magnitude) surface rupture were considered. The total length of potential surface fault rupture is commensurate with a magnitude 7.5 earthquake on the Blue Cut fault.

The maximum earthquake in the STR seismotectonic zone that is not constrained to a specific fault was estimated to be $M_w = 6.75$. Such an event is assumed to occur anywhere randomly within the STR zone. The earthquake magnitude was estimated based on consideration of historical seismicity as well as empirical fault length/ earthquake-magnitude relationships and seismic moment calculations as described in Volume 5, Appendix D-3, of the ROWD.

The maximum magnitude earthquake for a non-fault specific "random" source within the STR was selected to be a conservative upper bound. It considers not only historical seismicity within the STR, but all historical earthquakes within the State of California not associated with surface faulting or mapped faults. Examples of large California earthquakes without surface faulting are the Coalinga earthquake (M_w 6.4, 1983), Whittier Narrows earthquake (M_w 6.1, 1987), and most recently, the Northridge earthquake (M_w 6.7, 1994). The maximum earthquake within the STR was selected to exceed the historical examples and be conservative with respect to the geologic and tectonic setting of the STR.

The maximum magnitude of 6.75 was assigned for non-fault specific "random" STR earthquakes occurring in areas, where there is neither surface expression of faulting nor recognized subsurface geologic structures that are seismic sources. This type of random seismicity is unlike the Landers earthquake that occurred in the Mojave seismo-tectonic province north of the STR. The M_w 7.5 Landers earthquake occurred on a recognized geologic structure with surface expression of faulting and was not a random source. The maximum magnitude of 7.5 assigned to the Blue Cut fault, which is a known fault within the STR, is consistent with the Landers main event. The M_w 6.5 Big Bear aftershock from the Landers event and the M_w 6.4 Joshua Tree event, both within the STR, are less than the maximum magnitude of 6.75 assigned to STR events

not associated with surface faulting or known geologic structures. Thus, following the historical examples of random earthquakes in the STR and throughout other parts of California, the M_w 6.75 random source earthquake is not expected to be exceeded.

For the Eagle Mountain Landfill seismicity studies, activity rates for the principal causative faults, fault zones, and seismo-tectonic provinces were estimated using a combination of instrumental records of historic seismicity, detailed geologic information for faults with evidence of surface faulting, and regional geologic information on the long-term geologic slip rate of the fault or seismo-tectonic province. For each principal causative seismic source, all three types of information were compiled, evaluated for reliability (e.g., completeness of the historical catalog, level of detail of field studies), and integrated to provide an estimate of fault activity consistent with local geology and regional tectonics. Fault activity rates were then described using the Gutenberg-Richter logarithmic relationship. Complete details of this activity assessment are given by Martin [1992] (ROWD, Volume 5, Appendix D-3). Important aspects of the activity assessment are summarized briefly below.

For the Blue Cut fault, the closest recognized active or potentially-active fault to the project site, activity rates were based primarily upon field studies performed specifically for this project [Martin, 1992]. For the Pinto Mountain and San Andreas faults, the other fault-specific sources among the principal causative sources contributing to seismicity at the site, field studies reported in the literature were the primary data used to evaluate activity rates. Activity rates for the seismo-tectonic province source zones were based upon a combination of historical seismicity data (i.e., for the small magnitude end of the range, where the historical catalog is considered complete) and regional geologic slip rates (i.e., for the large magnitude end of the range). Seismicity associated with fault-specific sources (e.g., Blue Cut, Pinto Mountain, and San Andreas faults) was removed from the historic data and geologic slip rates in evaluating seismo-tectonic source activity rates to eliminate "double counting" of seismic events. The remaining seismo-tectonic source activity rates include both non-fault specific random seismicity and seismicity that may be in

proximity to known faults that have not exhibited ground surface displacement in Holocene or late Pleistocene time, including small local faults such as the Victory Pass and Substation faults.

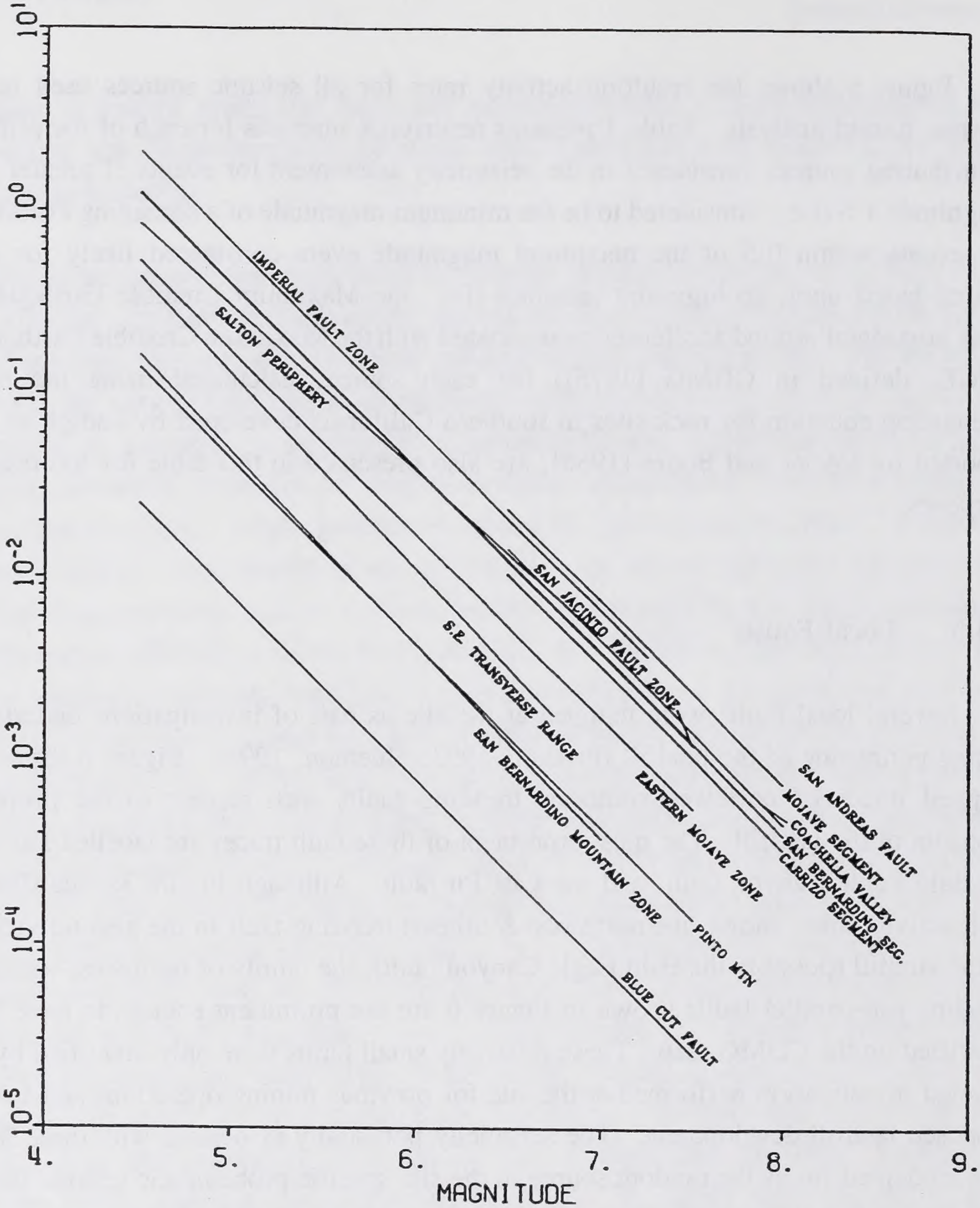
The three types of data considered to evaluate the rate of activity on the Blue Cut fault included: (i) historical seismicity; (ii) rate of seismic energy release constrained by average fault slip rate; and (iii) direct geologic data or paleoseismicity. For the Blue Cut fault, the very limited historical seismicity over the short observational period is insufficient to construct a meaningful Gutenberg-Richter logarithmic relationship. Historical seismicity could not be used to estimate representative recurrence intervals for the Blue Cut fault. Direct geologic evidence for slip rate on the Blue Cut fault is also not available. Left lateral offsets of features with known ages have not yet been reported from previous studies or from studies performed for the Eagle Mountain Landfill project (ROWD, Volume 5, Appendix D-3). Therefore, slip rate could not be used to estimate recurrence intervals of potential earthquakes on the Blue Cut fault. However, geologic and geomorphic data indicate that there may have been four major surface faulting events on the Blue Cut fault during the past 50,000 years (ROWD, Volume 5, Appendix D-3). Those data have been interpreted to represent a maximum magnitude earthquake of $M_w > 7.0$ once every 12,500 years on average. Using the regional "b" value of one, a Gutenberg-Richter recurrence curve was generated for the Blue Cut fault with a maximum magnitude of 7.5. The slip rate for the Blue Cut fault was back-calculated based on the identified geologic data constraints on recurrence interval and maximum magnitude. As a parametric study, recurrence curves were generated for various slip rates on the Blue Cut fault ranging from 0.1 to 1.0 mm/year, consistent with faults in the Mojave block and STR. However, the best fit of the geologic data and judgement is a slip rate of 0.3 mm/year (ROWD, Volume 5, Appendix D-3). The slip rate cited is believed to be the upper range of possible slip rate for the Blue Cut fault. Higher slip rates are not consistent with the geologic data and geomorphic expression of the fault.

Figure 5 shows the resulting activity rates for all seismic sources used in the seismic hazard analysis. Table 1 presents recurrence intervals for each of the primary contributing sources considered in the seismicity assessment for events of greater than magnitude 4.5 (i.e., considered to be the minimum magnitude of a damaging event) and for events within 0.5 of the maximum magnitude event considered likely for each source based upon geology and tectonics (i.e., the Maximum Credible Earthquake). Peak horizontal ground accelerations associated with the Maximum Credible Earthquake (MCE, defined in CDMG [1975]) for each source, calculated using the mean attenuation equation for rock sites in southern California developed by Sadigh as reported by Joyner and Boore [1988], are also presented in this table for information purposes.

3.4.3 Local Faults

Several local faults were mapped at the site as part of investigations undertaken during permitting of the landfill [Proctor, 1993; Shlemon, 1993]. Figure 6 shows the mapped traces of northwest-southeast trending faults with respect to the proposed footprint of the landfill. The most prominent of these fault traces are labelled Fault A, the Bald Eagle Canyon fault, and the East Pit fault. Although Figure 3a, the CDMG fault activity map, shows one northwest-southeast trending fault in the general vicinity of the landfill (possibly the Bald Eagle Canyon fault), the family of northwest-southeast trending sub-parallel faults shown in Figure 6 are not prominent enough to have been identified on the CDMG map. These relatively small faults were only identified by the detailed investigation performed at the site for previous mining operations and for the proposed landfill development. The seismicity potentially associated with these faults was accounted for as the random source in the site-specific probabilistic seismic hazard analysis as part of Southeast Transverse Ranges seismo-tectonic province.

Because only the northwest-southeast trending faults transect the landfill footprint, only these faults are a factor with respect to the potential for active faulting within or



SOURCE: APPENDIX D, MARTIN, [1992].

EAGLE MOUNTAIN
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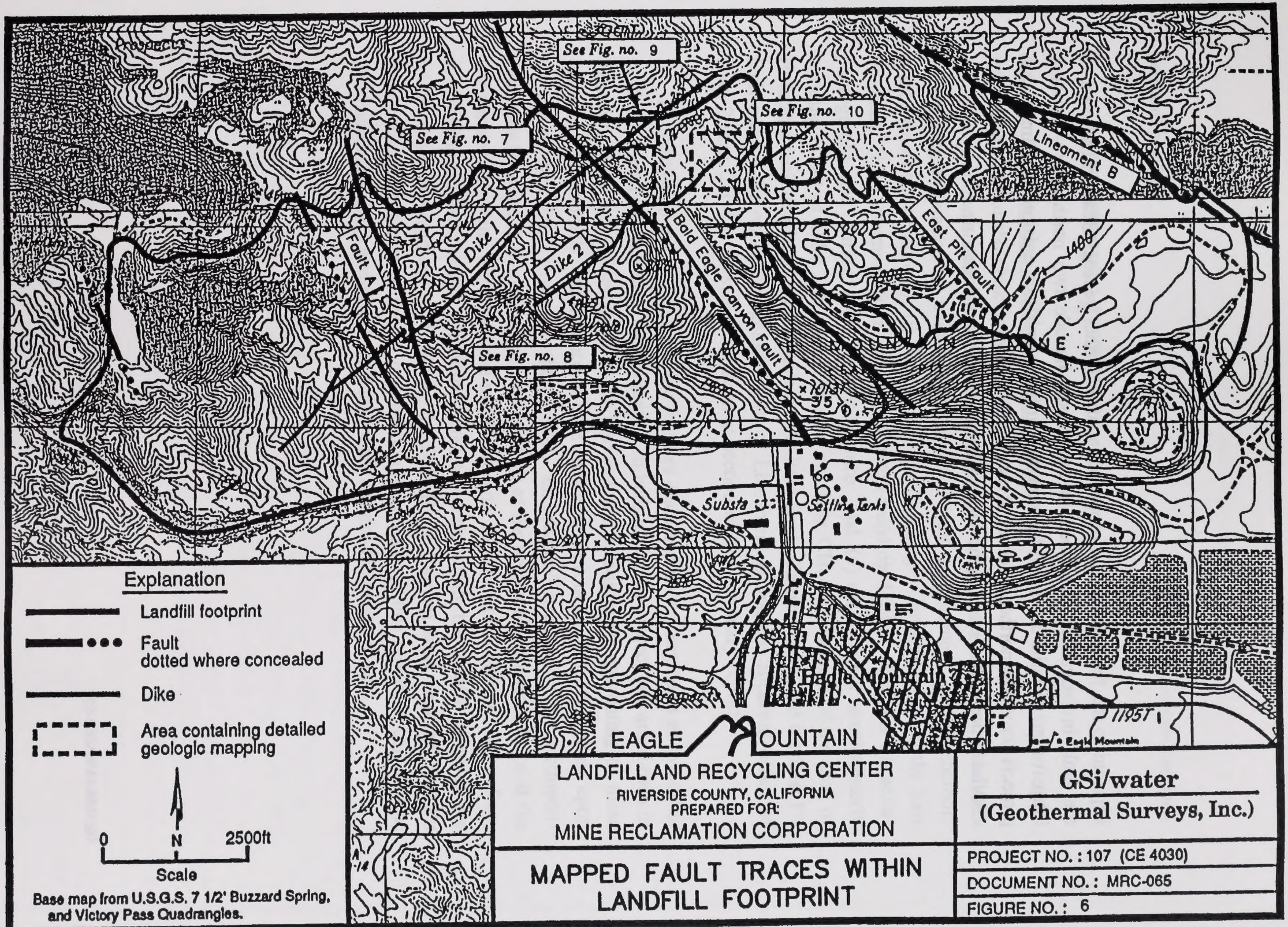
GEOSYNTEC CONSULTANTS
HUNTINGTON BEACH, CALIFORNIA

RECURRENCE RATES FOR VARIOUS SEISMIC SOURCES

PROJECT NO.:	CE4030-02
DOCUMENT NO.:	MRC-065
FIGURE NO.:	5

4030E071 199212031730



Explanation

- Landfill footprint
- Fault dotted where concealed
- Dike
- Area containing detailed geologic mapping

N

0 2500ft

Scale

Base map from U.S.G.S. 7 1/2' Buzzard Spring, and Victory Pass Quadrangles.

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MAPPED FAULT TRACES WITHIN LANDFILL FOOTPRINT

GSi/water
(Geothermal Surveys, Inc.)

PROJECT NO. : 107 (CE 4030)
DOCUMENT NO. : MRC-065
FIGURE NO. : 6

adjacent to the footprint of the proposed landfill. Other geologic features relevant to the fault investigations described in this report include two northeasterly-trending intrusive quartz latite dikes that transect the faults, a significant erosional lineament that projects across the northeast corner of the landfill footprint, and undisturbed Quaternary alluvial deposits that exist at the range front of the Eagle Mountains.

4. SITE-SPECIFIC STUDIES

4.1 Identification of Geomorphic Features

Five prominent northwest-southeast trending geomorphic features were identified as requiring evaluation for evidence of Holocene fault displacement, or lack thereof, at the project site (Figure 6): (i) Fault A; (ii) the Bald Eagle Canyon fault; (iii) the East Pit fault; (iv) Lineament B, a strong northwest-trending feature observed on aerial photographs and during aerial reconnaissance; and (v) an apparent northwesterly trending offset of Dike 2 in the vicinity of corehole CH-4. Evidence of the lack of Holocene fault displacement on Fault A, the Bald Eagle Canyon fault, and the East Pit fault and of the non-seismogenic origin of Lineament B and the apparent offset of Dike 2 near CH-4 is presented in the next section of this summary report.

In addition to the five geomorphic features discussed above, segments of two other northwest-southeast trending faults mapped in bedrock at the project site are shown in Figure 6. The lack of sediment cover prevents soil stratigraphic age dating of these features. Additionally, the absence of dike crossings prevent an evaluation based upon the age of the dikes. However, the parallel, "en echelon" structure of the northwest-southeast trending fault system indicates that all of the northwest-southeast faults at the site formed at around the same time under the same tectonic stress regime. Therefore, it is concluded that the two additional faults segments within the landfill footprint are of the same geologic age as Fault A, the Bald Eagle Canyon fault, and the East Pit fault. Based on the information presented subsequently in this report, it can also be concluded that these additional fault segments are pre-Holocene in age.

4.2 Studies of Fault Activity

4.2.1 Bald Eagle Canyon Fault

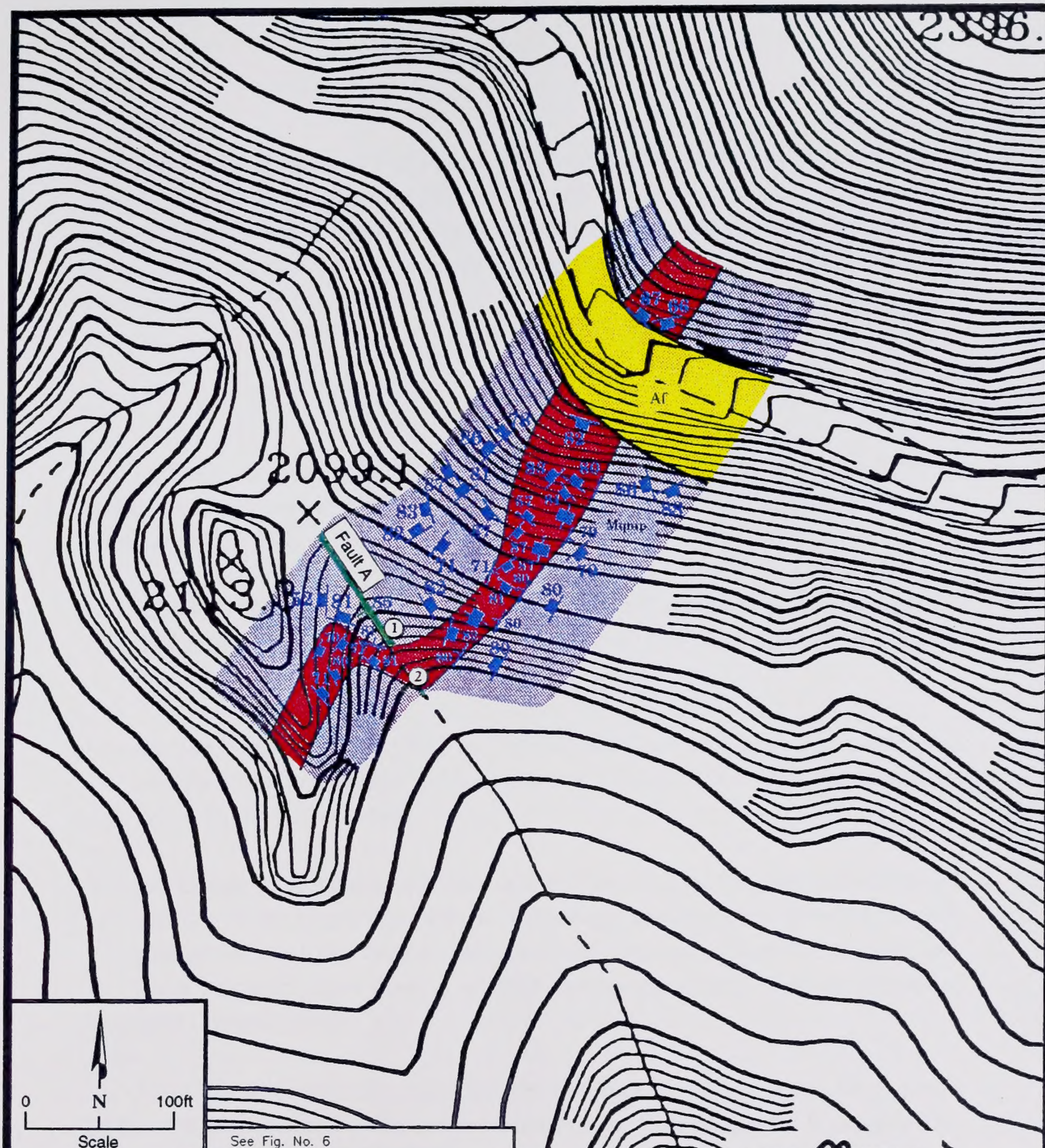
Evidence that displacement has not occurred on the Bald Eagle Canyon fault in over 11,000 years includes observations of unbroken alluvium from pre-mining aerial photographs, field trenching, and exposures of the fault trace in the East Pit wall. This evidence is summarized as follows:

- unbroken pre-Holocene alluvium in Trench 1 above the projection of the Bald Eagle Canyon fault, dated as at least 12,000 to 15,000 years old and possibly up to 40,000 to 100,000 years old, shows no evidence of fault offset [Shlemon, 1993; Proctor, 1993];

- unbroken pre-Holocene alluvium above the projection of the Bald Eagle Canyon fault exposed in the East Pit has been dated as at least 40,000 years old and shows no evidence of fault offset [Shlemon, 1993; Proctor, 1993]; and

- pre-mining aerial photographs from the Whittier College Fairchild collection and the files of the Kaiser Corporation at the Eagle Mountain site show no disruption of well-patinated alluvial surfaces, which have been dated as at least 40,000 years old, above the projection of the Bald Eagle fault across the East Pit [Shlemon, 1993; Proctor, 1993].

From this evidence, it is concluded that Holocene displacement has not occurred on the Bald Eagle Canyon fault in the vicinity of the Eagle Mountain site. This conclusion is supported by detailed geologic mapping of the areas where Dikes 1 and 2 cross the Bald Eagle Canyon fault. Results of the mapping are presented in Figure 7. As can be seen in the figure, the dikes are not offset at the fault contacts [GSi/water, 1993]. Dikes 1 and 2 have been dated as 120 and 230 million years old, respectively, using K-Ar dating techniques [Geochron, 1993]. These ages are consistent with the



Explanation

Af	Artificial Fill *	17	Strike and dip of fracture
Mqmp	Granitic rocks *		Vertical fracture
	Quartz Latite dike	52	Strike and dip of lithologic contact
	Fault	85	Strike and dip of fault
	Geologic contact	①	Location of photograph referred to in text

(* See Plate 1 ROWD for detailed descriptions)

Base map from Cooper Aerial Survey Co.

EAGLE MOUNTAIN
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DETAILED GEOLOGY
FAULT "A"

GSi/water
(Geothermal Surveys, Inc.)

DATE: 6/1/93	MAPPED: 5/93
DESIGN BY: THH	JOB NO.: 107 (CE 4030)
DRAWN BY: DWB	FILE NO.: N/A
CHECKED BY: THH	DOCUMENT NO.: MRC-065
REVIEWED BY: RAS (PROJ. MGR.)	FIGURE No. 8
APPROVED BY: JHB (PRINCIPAL)	

ages of 142 million years to 383 million years reported by James [1989] for northerly trending dikes in the Eagle Mountains southwest of the landfill footprint. Based on the ages of the dikes and the lack of observable offset at the fault contacts, the period of seismogenic activity on the Bald Eagle Canyon fault occurred more than 100 million years ago.

4.2.2 Fault A

Evidence that displacement has not occurred on Fault A in over 11,000 years includes observations of unbroken alluvium from pre-mining aerial photographs and field trenching. This evidence is summarized as follows:

- unbroken alluvium observed in a trench across the projection of Fault A south of the landfill (Trench 2) has been dated as at least 40,000 years old [Shlemon, 1993; Proctor, 1993];
- a bedrock exposure of the fault in a stream bed south of Trench 2 is overlain by unbroken alluvium, which has been dated as at least 40,000 years old [Shlemon, 1993; Proctor, 1993]; and
- pre-mining aerial photographs from the Whittier College Fairchild collection and the files of the Kaiser Corporation at the Eagle Mountain site show that a well-patinated alluvial fan surface, which has been dated as at least 40,000 years old, is not displaced above Fault A where it crosses the landfill footprint [Shlemon, 1993; Proctor, 1993].

From this evidence, it is concluded that Holocene displacement has not occurred on Fault A in the vicinity of the Eagle Mountain site. This conclusion is supported by detailed geologic mapping of the area where Dike 1 crosses Fault A, shown in Figure 8. The results of the mapping indicate that the dike is not offset at its contact

with the fault [GSi/water, 1993]. The mapping results also indicate that an observed irregularity in Dike 1 near Fault A trend is not due to fault offset but is instead due to irregular intrusion of the dike along preferred joints and other fractures in the bedrock. A good example of this natural irregularity is the irregularity of Dike 1 in the vicinity of the Bald Eagle Canyon fault, as shown in Figure 9. The lack of observable offset of the dike at the fault contact, coupled with the age of the dike, indicates that the period of seismogenic activity on Fault A occurred more than 100 million years ago.

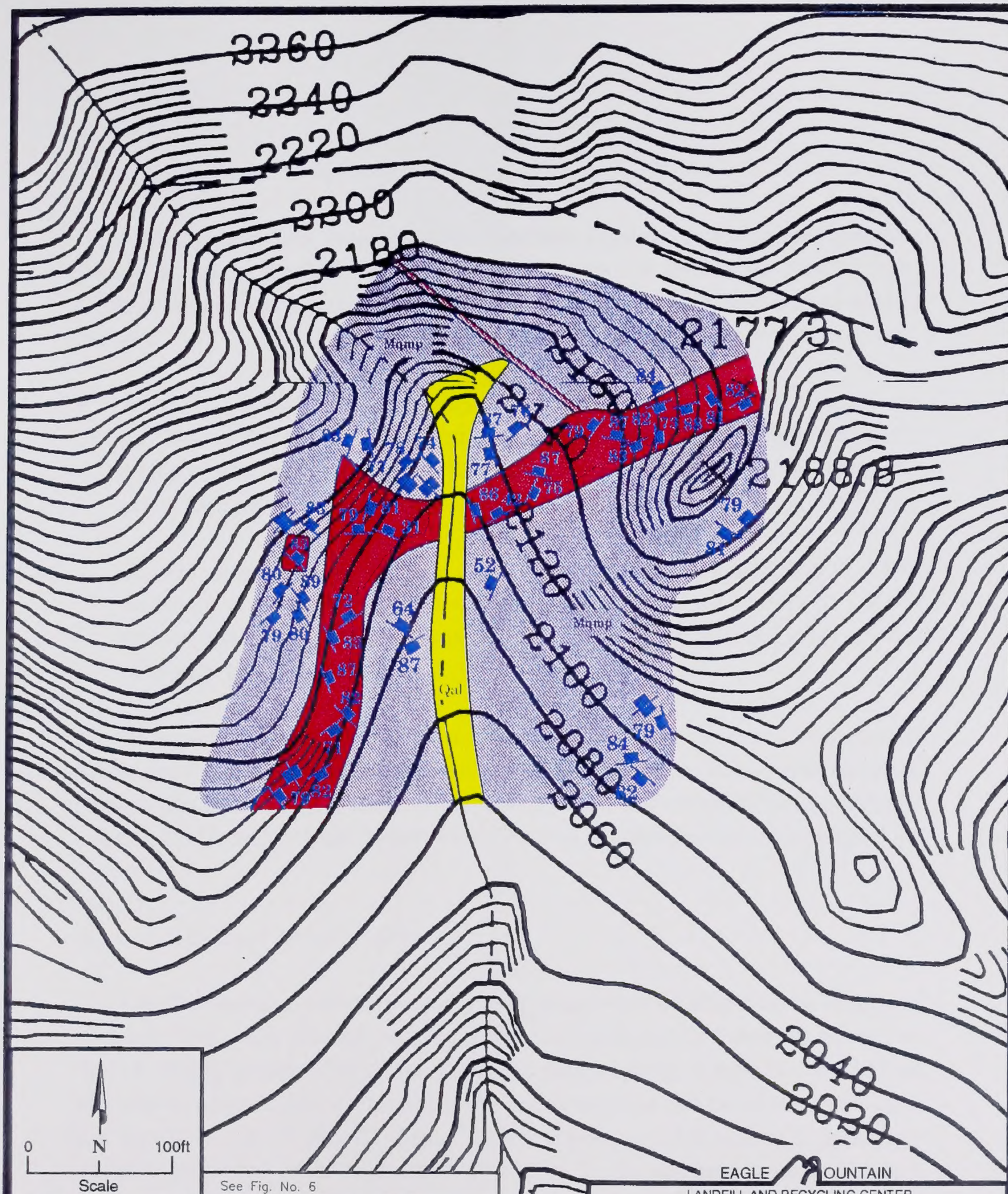
4.2.3 East Pit Fault

Evidence that displacement has not occurred on the East Pit fault in over 11,000 years includes observations of unbroken alluvium over the fault in pre-mining aerial photographs and field observations of unbroken alluvium overlying the fault in the wall of the East Pit. This evidence is summarized as follows:

- pre-mining aerial photographs from the Whittier College Fairchild collection and the files of the Kaiser Corporation at the Eagle Mountain site show unbroken alluvium, which has been dated as at least 40,000 years old, above the projection of the East Pit fault [Shlemon, 1993; Proctor, 1993]; and

- approximately 270 ft (82 m) of unbroken alluvium, which has been dated as at least 100,000 years old, is exposed in the wall of the East Pit overlying the East Pit fault [Shlemon, 1993; Proctor, 1993].

From this evidence, it is concluded that Holocene displacement has not occurred along the East Pit fault in the vicinity of the Eagle Mountain Landfill site.



See Fig. No. 6

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Explanation

Qal	Alluvium *		Geologic contact
Mqmp	Granitic rocks *	17	Strike and dip of fracture
	Quartz Latite dike		Vertical fracture
	Mafic dike	52	Strike and dip of lithologic contact

(* See Plate 1 ROWD for detailed descriptions)

Base map from Cooper Aerial Survey Co.

DETAILED GEOLOGY
EAST OF BALD EAGLE CANYON FAULT

GSi/water (Geothermal Surveys, Inc.)	DATE : 6/1/93	MAPPED : 5/93
	DESIGN BY : THH	JOB NO. : 107 (CE 4030)
	DRAWN BY : DWB	FILE NO. : N/A
	CHECKED BY : THH	DOCUMENT NO. : MRC-065
	REVIEWED BY : RAS (PROJ. MGR.)	FIGURE No. 9
	APPROVED BY : JHB (PRINCIPAL)	

4.2.4 Lineament B

Aerial photographs show a strong lineament trending northwest-southeast that projects across the northeast corner of the landfill footprint north of the East Pit fault. Evidence supporting the conclusion that Lineament B is not a fault-related feature includes:

- pre-mining aerial photographs from the Whittier College Fairchild collection and the files of the Kaiser Corporation at the Eagle Mountain site show unbroken, well-patinated alluvium, which has been dated as at least 40,000 years old, overlying Lineament B in the vicinity of the landfill footprint [Proctor, 1993]; and

- detailed mapping along a linear canyon approximately one-half mile (0.8 km) northwest of the landfill performed during preparation of the ROWD-SV1 led to the conclusion that Lineament B is not a fault but a canyon eroded along a series of closely spaced joints [Proctor, 1993; GeoSyntec, 1993a].

Moreover, apparently undisturbed alluvium overlying a northwest projection of Lineament B about 2 miles (3 km) north of the landfill footprint was observed in aerial photographs. In summary, these various investigations and observations indicate that Lineament B is an erosional feature whose location is controlled by bedrock jointing.

4.2.5 Apparent Offset of Dike 2

Detailed mapping was performed of an apparent offset of Dike 2 in the vicinity of corehole CH-4. The detailed mapping of the area, presented in Figure 10 showed no sign of faulting or fault offset. Based upon the field mapping, it appears Dike 2 is not offset but is discontinuous in this area. This conclusion is supported by the observation that directly north of Dike 2, Dike 1 clearly shows no offset across a northwest-southeast projection of the apparent offset in Dike 2. In summary, evidence for lack

of Holocene faulting in the vicinity of the apparent offset in Dike 2 includes:

- no evidence of faulting in the area of the apparent offset [GeoSyntec, 1993a]; and
- no evidence of an offset in Dike 1 northwest of the area of apparent offset of Dike 2 [GeoSyntec, 1993a].

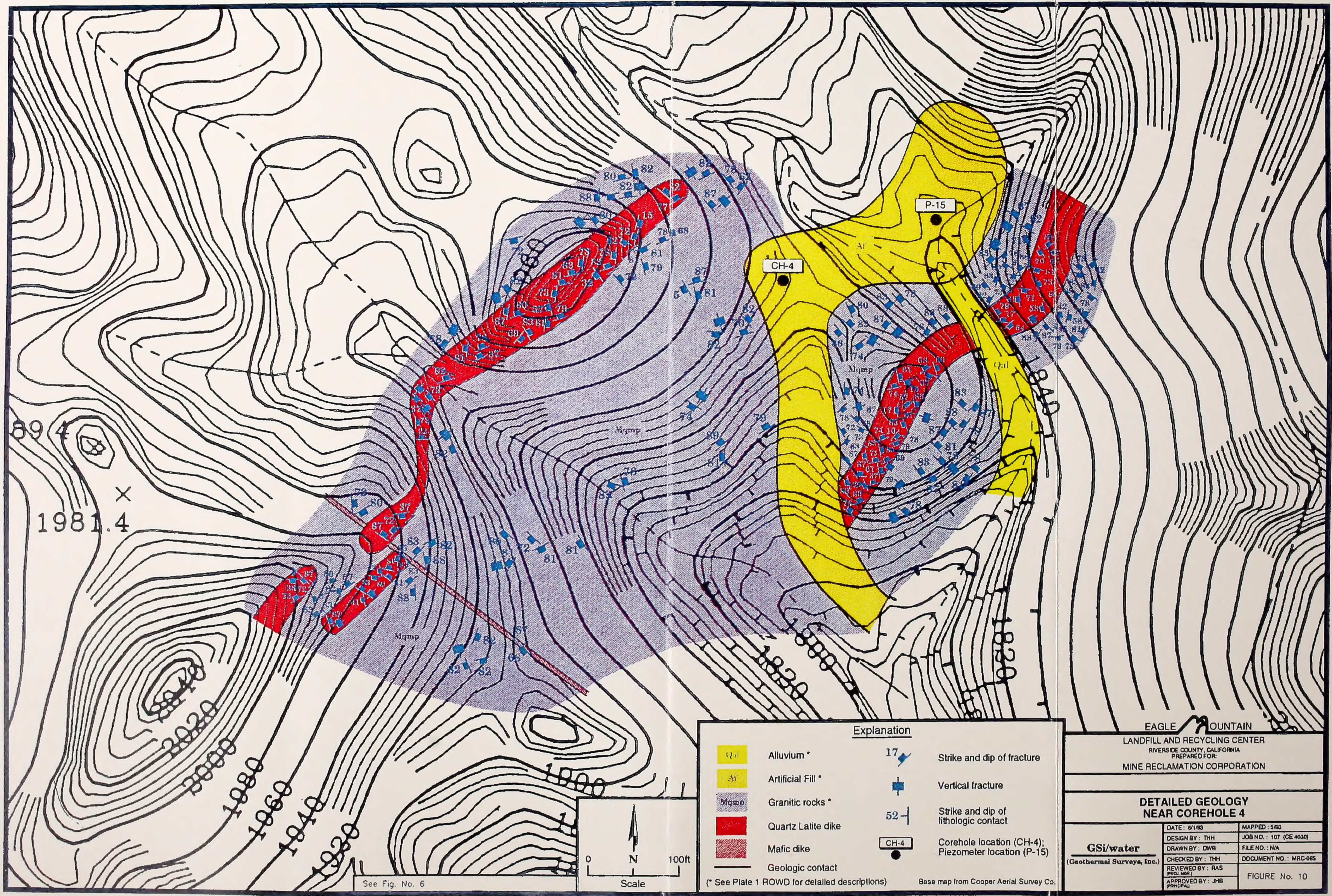
In conclusion, the physical evidence indicates that the apparent offset of Dike 2 in the vicinity of corehole CH-4 is due to irregular and discontinuous intrusion of the dike along preferred joints and other fractures in the bedrock.

4.3 Strong Shaking Hazard

4.3.1 Hazard Assessment following Federal Regulations

Federal Subtitle D regulations for seismic design of MSWLF provide a prescriptive seismic design standard based upon the maximum horizontal acceleration (MHA) in lithified earth (bedrock) at the site with a 90 percent or greater probability of not being exceeded in 250 years, as depicted on a seismic hazard map. The MHA is typically evaluated from United States Geological Survey (USGS) Map Sheet MF-2120 [USEPA, 1990]. This map is commonly referred to as the "Algermissen" map. As an alternative to evaluating the MHA from a seismic hazard map, the Subtitle D regulations also provide for the alternative approach of evaluating the MHA based upon a site-specific analysis. However, USEPA provides little guidance on what constitutes an acceptable site-specific analysis [USEPA, 1995].

A site-specific probabilistic seismic hazard assessment was performed for the Eagle Mountain Landfill by Earth Mechanics [1992] using the computer program SEISRISK III [Bender and Perkins, 1987].



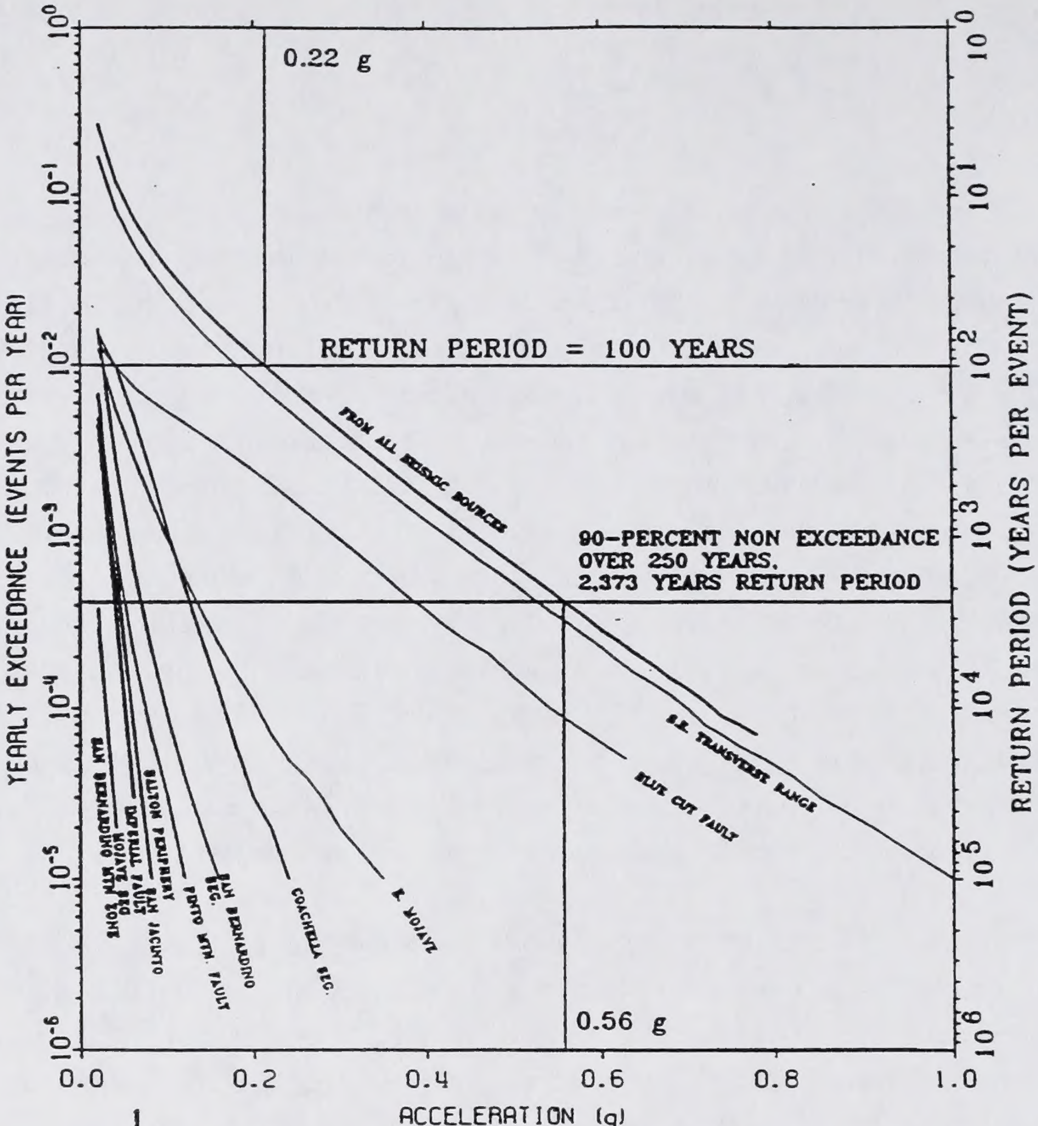
CH-4
P-15
Mgmp
Qal
Af
1981.4
1980
1960
1940
1920
1900
1820
1840
2000
2020
0
N
100ft
Scale
See Fig. No. 6
Explanation
Alluvium *
Artificial Fill *
Granitic rocks *
Quartz Latite dike
Mafic dike
Geologic contact
Strike and dip of fracture
Vertical fracture
Strike and dip of lithologic contact
Corehole location (CH-4); Piezometer location (P-15)
(* See Plate 1 ROWD for detailed descriptions)
Base map from Cooper Aerial Survey Co.
EAGLE MOUNTAIN
LANDFILL AND RECYCLING CENTER
RIVERSIDE COUNTY, CALIFORNIA
PREPARED FOR:
MINE RECLAMATION CORPORATION
DETAILED GEOLOGY
NEAR COREHOLE 4
GSi/water
(Geothermal Surveys, Inc.)
DATE: 6/1/93
DESIGN BY: THH
DRAWN BY: DWB
CHECKED BY: THH
REVIEWED BY: RAS (PROJ. MGR.)
APPROVED BY: JHB (PRINCIPAL)
MAPPED: 5/93
JOB NO.: 107 (CE 4030)
FILE NO.: N/A
DOCUMENT NO.: MRC-065
FIGURE No. 10

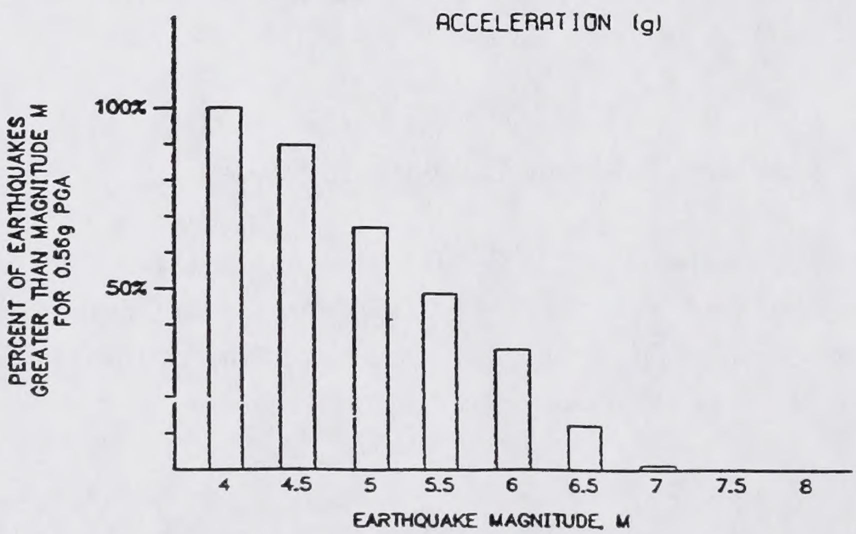
Input data to the analysis on seismic source zones and associated activity rates was provided by the regional and local seismicity studies described in Section 3.4 of this report. These data are summarized in Figure 5 and Table 1. Figure 11 shows the results of the probabilistic hazard analysis performed using the data in Figure 5 and Table 1. Despite the difference in assumptions between the analyses used to generate the Algermissen maps and the site-specific probabilistic analyses, the site-specific probabilistic seismic hazard analysis yielded 0.56 g as the MHA, in substantial agreement with the prescriptive Subtitle D MHA from the Algermissen map. The magnitude distribution corresponding to this 0.56 MHA value from the site-specific probabilistic seismic hazard analysis is also shown in Figure 5. The probabilistic hazard curves and this magnitude distribution indicates that over 98 percent of the earthquakes contributing to the 0.56 g MHA were from the STR regional (i.e., random) source and were of magnitude 6.5 or smaller. Further analysis of the probabilistic hazard analysis results indicate that over 98 percent of the earthquakes contributing to the 0.56 g MHA occur at a distance of 5 miles (8 km) or less.

Based on the results described above, an earthquake magnitude of between 6.0 and 6.5 at a distance of 5 miles (8 km) from the site was assigned to a 0.56 g peak ground acceleration (PGA) to describe the prescriptive Subtitle D design earthquake. This design earthquake may be attributed to either non-fault specific random seismicity in the vicinity of the site or to an earthquake on the nearby Blue Cut Fault.

4.3.2 Hazard Assessment Following California Regulations

California regulations specify that MSWLF be designed to withstand the MPE in accordance with CDMG guidelines. CDMG [1975] defines the MPE as the maximum earthquake expected to impact the site in a 100 year period. Under CDMG guidelines, the MPE is evaluated from a site-specific seismic hazard analysis.





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GEOSYNTEC CONSULTANTS
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PROBABILISTIC HAZARD ANALYSIS RESULTS FOR THE EAGLE MOUNTAIN LANDFILL

FIGURE NO.	11
PROJECT NO.	GE3586-18
DATE:	MAY-13-96

DWG: 3586F001 199605131709 AB

The site-specific probabilistic seismic hazard assessment, illustrated in Figure 11, resulted in a PGA with an expected (mean) recurrence interval (return period) of 100 years equal to 0.22 g. Approximately 75 percent of the earthquakes associated with this PGA are events of magnitude 6.0 or less associated with the STR seismo-tectonic source. The other 25 percent of earthquakes associated with this PGA are from the Blue Cut fault. The PGA with a return period of 100 years for the Blue Cut fault zone is less than 0.10 g and the return period for an earthquake on the Blue Cut fault generating a PGA of 0.22 g at the site is well in excess of 1,000 years. On this basis, the MPE for the STR source zone was established as a magnitude 6.0 to 6.5 earthquake generating a PGA of 0.22 g at the site.

In a review of the ROWD by the California Department of Water Resources (DWR), the possibility was raised that a larger magnitude "far-field" earthquake on the San Andreas fault with a lower intensity than 0.22 g might be more damaging than the near-field STR MPE described in the preceding paragraph. Based on the findings of the Working Group on the Probabilities of Future Large Earthquakes in Southern California (WGPFLESC) [1992], a magnitude 7.8 event due to concurrent rupture of the Coachella Valley and San Bernardino Mountains segments of the San Andreas fault was identified as representative of the MPE event along the southern California portion of the San Andreas fault system. Using the mean attenuation relationship of Sadigh as reported by Joyner and Boore (1988) and using the closest approach of the fault to the site, 33 miles (53 km), as the source to site distance, this MPE event is associated with a free field PGA of 0.14 g at the Eagle Mountain Landfill site.

As part of the evaluation performed in response to DWR comments, the magnitude and PGA associated with a MCE on the San Andreas fault was also evaluated. The MCE is defined by CDMG [1975] as the maximum earthquake capable of occurring under the presently known tectonic framework. Based upon the WGPFLESC [1992] studies, a magnitude 8.0 earthquake event associated with simultaneous rupture of three segments of the San Andreas fault was identified as the MCE for the southern California portion of the San Andreas fault system. Using the mean attenuation

relationship from Sadigh, this MCE event is associated with a free field PGA of 0.16 g at the Eagle Mountain Landfill site.

4.3.3 Representative Time Histories

A suite of representative time histories was selected for both the prescriptive Subtitle D design event and the California MPE events for use in the seismic performance analyses of the landfill. Time histories were selected to represent the "rock site" foundation conditions and the mechanism, magnitude, PGA, and source to site distance of the design events. A suite of eleven different accelerograms recorded in California from earthquakes of magnitude 5.9 to 7.1 were used to characterize the prescriptive Subtitle D design earthquake and the "near-field" Southeast Transverse Ranges MPE event. Each of the time histories was scaled to a PGA of 0.56 g for the prescriptive Subtitle D event and 0.22 g for the near-field MPE event for the seismic performance analyses. These time histories were as follows:

- the Gilroy record from the magnitude 5.9 Coyote Lake earthquake; PGA of this record was 0.32 g;
- both components of the magnitude 5.9 Whittier recording at the Garvey Reservoir Control Building; PGA for these records were 0.37 g and 0.48 g;
- both components of the Cholame 5 record from the 1966 magnitude 6.0 Parkfield event; the PGA for these records were 0.35 g and 0.43 g;
- both components of the Cholame 8 record from the 1966 magnitude 6.0 Parkfield event; the PGA for these records were 0.24 g and 0.28 g;
- both components of the Corralitos record from the 1989 magnitude 7.1 Loma Prieta earthquake; the PGA for these records were 0.48 g and 0.63 g; and

- both components of the University of California, Santa Cruz record from the 1989 magnitude 7.1 Loma Prieta earthquake; the PGA for these records were 0.41 g and 0.44 g.

Selection of representative recorded accelerograms for the far-field MPE design event was complicated by the lack of available rock site records from large magnitude earthquakes. The following four accelerograms were selected to represent the magnitude 7.7 MPE event at the site:

- both components of the Taft record from the magnitude 7.7 Kern County earthquake of 1952; the PGA for these records were 0.16 g and 0.18 g.
- the Silent Valley record from the magnitude 7.4 Landers earthquake of 1992; the PGA of this record was 0.05 g; and
- the Twenty-Nine Palms record from the magnitude 7.4 Landers earthquake of 1992; the PGA of this record was 0.06 g.

In part to compensate for the difference in magnitude between the Landers records and the MPE and in part to provide a conservative basis for design, the above records were scaled to the MCE PGA of 0.16 g for use in the seismic performance analyses of the landfill.

4.4 Secondary Seismic Hazards

Secondary seismic hazards are hazards induced by the primary seismic hazards of strong ground shaking and fault rupture. Secondary hazards include slope instability, liquefaction, seismic settlement, tsunamis, and seiches.

Liquefaction is a phenomenon in which near-surface deposits of loose to medium dense saturated cohesionless soils temporarily loose their consistency and behave like a viscous fluid. Potential liquefiable materials include waste, alluvium, debris flow deposits, cohesionless fill, and coarse tailings materials. At the site, these materials are typically dry and are not expected to be saturated for any significant period of time. Therefore, liquefaction of these materials is not a design consideration.

Potentially liquefiable materials that are not saturated may be susceptible to seismically induced settlement. Of the potentially liquefiable materials identified above, only the alluvium and cohesionless fill will underlie or otherwise support waste. All cohesionless fill placed at the site will be compacted to at least 90 percent relative compaction, measured according to the modified Proctor compaction test (ASTM D 1557). Fill compacted to this density is not susceptible to seismic settlement. Field studies indicate the alluvium at the site is greater than 40,000 years old. Field studies [Youd and Hoose, 1976; Youd and Perkins, 1978] have demonstrated that geologic deposits more than 20,000 years old are extremely resistant to liquefaction, and hence seismic settlement. Combined with field observations that the alluvium at the site is generally dense to very dense, this indicates that seismic settlement of the alluvium is not a design consideration.

In Subsection 5.1.2 of this report, it is shown that the potential for seismic slope instability of natural and man-made slopes at the project site is low. The rock slopes at the site are inherently stable. Ravelling of surficial cobbles and boulders may occur during strong seismic shaking at the site. However, this is not considered to be of engineering significance with respect to the landfill integrity. Coarse-grained soils placed at the site in an uncontrolled manner (i.e., coarse tailings) may undergo surficial instability and sloughing and settlement during strong seismic shaking. Seismic sloughing and settlement of the tailings piles is also not considered of engineering significance, with respect to landfill integrity. Lined waste slopes may undergo displacement under seismic loading due to the low shear resistance of the liner system. However, lined slopes will be configured such that permanent deformations that may

accumulate during strong shaking are designed not to affect the integrity of the liner system.

Tsunamis and seiches are large waves that are seismically generated. Tsunamis occur on very large bodies of water, like oceans, which overlie the seismic source, while seiches occur on smaller, land-locked bodies of water, like lakes. Because of the Eagle Mountain Landfill site's remoteness from bodies of water, there is no likelihood of tsunamis or seiches affecting the project.

5. SEISMIC STABILITY ANALYSES

5.1 Analyses Performed for the ROWD

5.1.1 General

The following sections of this report summarize the seismic analyses performed during preparation of the ROWD report [GeoSyntec 1992]. Several different categories of static and seismic slope stability analyses were performed to confirm that the shear strength properties of the natural and engineered materials included in the landfill design, coupled with the proposed geometry of the landfill (i.e., waste management unit), result in adequate slope stability factors of safety.

The engineering slope stability and deformation analyses used the methods and computer implementations of the methods presented in Table 2. The table indicates the analysis categories to which each method was applied. The methods shown in the table were selected for use due to the capabilities inherent in the methods and the widespread acceptance of the methods in the engineering community. Pseudo-static seismic slope stability studies were performed to analyze the natural slopes and the existing man-made slopes while seismic deformation analyses were performed to evaluate the stability of the liner and cover system.

5.1.2 Seismic Performance of Natural Slopes and of Existing Man-made Slopes

Natural slopes at the site are largely composed of bedrock with local areas of thin soil cover. The stability of natural rock slopes is primarily controlled by the characteristics of discontinuities in the rock mass (i.e. joints, fractures, or bedding planes), since, within hard rock, displacement typically occurs only along discontinuities. Two-dimensional (2-D) and three-dimensional (3-D) static and seismic (earthquake) stability analyses were conducted to evaluate a single rock slope with a height of 400 ft (120 m) and inclination of 0.75H:1V (horizontal:vertical).

Table 2. Slope Stability Analysis Methods Used to Evaluate Eagle Mountain Landfill Performance

ANALYSIS METHODOLOGY		COMPUTER IMPLEMENTATION		ANALYSIS CATEGORY				
Description	**Reference**	**Code**	**Reference**	**Natural Slopes**	**Existing Man-Made Slopes**	**Liner System Short-Term**	**Waste Mass (Interim and Final)**	**Final Cover**
3-D discontinuous rock slope kinematics	Hoek and Bray [1977]	none	none	x	x			
3-D discontinuous rock slope stability	Hoek and Bray [1977]	GEOSLIDE PROSLIDE	Carter and Lajtai [1992]	x	x			
2-D limit equilibrium stability	Giroud and Beech [1989]	none	none					x
2-D limit equilibrium stability for circular surfaces (modified Bishop method) and non-circular surfaces (simplified Janbu method and Spencer method)	Bishop [1955] Janbu [1973] Spencer [1967]	XSTABL (v. 4.00) STABGM (v. 9.85)	Sharma [1991] Duncan, et al. [1985]	x	x	x	x	x
2-D and 3-D limit equilibrium stability for wedge-type surfaces	Classical Method	none	none			x		
3-D limit equilibrium stability	Hungr [1987]	CLARA (v. 2.31)	Hungr [1988]				x	
2-D and 3-D slope deformation analysis for earthquake loading	Newmark [1965]	YSLIP-C	Yan [1991]				x	x
2-D seismic response analysis for earthquake loading	Schnabel et al. [1972]	SHAKE	Schnabel et al. [1972]				x	

Discontinuities in the rock slope were characterized by the three primary joint sets that have been mapped at the site. It was also assumed that the strike of the slope could take any azimuth from 0 to 360 degrees. This single slope represents a worst-case condition for either existing or construction-phase rock slopes within the landfill footprint. The analyses are for the time period prior to landfill development and filling. After filling, the waste mass will buttress the natural slopes, thereby increasing the rock slope factor of safety. The analyses demonstrated that the natural bedrock slopes will remain stable under both static and seismic conditions with an adequate factor of safety. From the evaluation, it is concluded that the natural bedrock slopes do not represent an area of rapid geologic charge, as required by §2533.(e) of Chapter 15, or an unstable geologic area as required by Subtitle D, Section 258.15.

Similarly, man-made slopes present at the site must continue to remain stable so that the landfill may be safely constructed and operated. Seismic stability analyses were performed for the walls of the East Pit that were excavated into fractured bedrock materials during previous mining operations. The walls have average inclinations of approximately 1.3H:1V (horizontal:vertical) and maximum heights of approximately 700 ft (200 m). They were constructed in a slope-and-bench configuration with 30- to 40-ft (9- to 12-m) high near-vertical backwalls between horizontal benches.

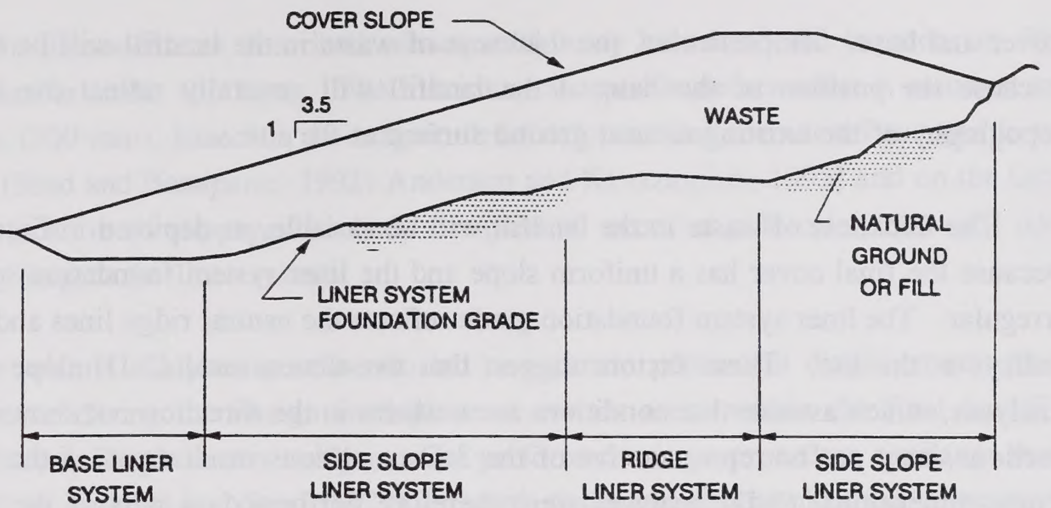
A minimum acceptable slope stability factor of safety of 1.5 was established for long-term static stability of the natural and man-made slopes. A minimum acceptable slope stability factor of safety of 1.1 was established for seismic stability of natural and man-made slopes when analyzed using a method with the following characteristics: (i) the factor of safety is computed assuming pseudo-static conditions; and (ii) a pseudo-static acceleration equal to the design horizontal ground acceleration at the site is used with the method. This approach to seismic analysis is very conservative because, in the design earthquake event, the horizontal ground acceleration is applied for a very short period, less than a second. An acceleration of this short duration will have little effect on a hard rock slope because the seismic forces are not sustained long enough to cause significant rock movement. In contrast, the pseudo-

static design analysis implicitly assumes a sustained application of the seismic force. Because of these factors, pseudo-static accelerations on the order of one-half to one-third the peak horizontal ground acceleration are typically used in practice [Hynes and Franklin, 1984], compared to the full peak ground acceleration used in the analyses described herein.

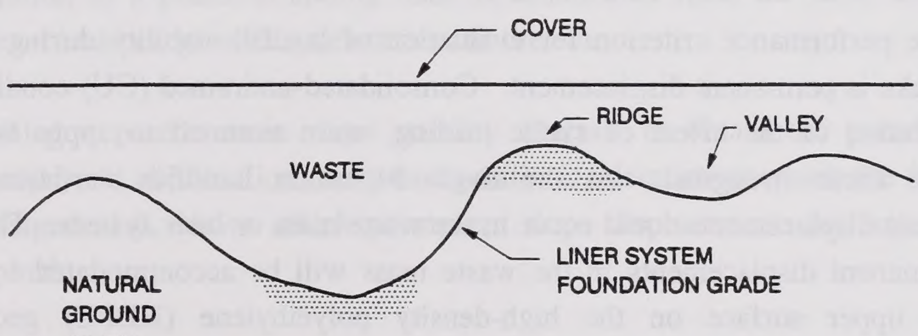
The design earthquake event for the seismic slope stability analysis of the natural and man-made slopes was taken as the near-field MPE as the peak acceleration from the near-field MPE event exceeded that of the far-field MPE event. As described previously, the seismic hazard assessment conducted for the site resulted in a near-field MPE peak horizontal ground acceleration at the site of 0.22 g. This value of ground acceleration was used for the seismic stability analysis of the natural cut rock slopes. Both average and lower-bound material strength parameters were used in the stability analyses for the natural and man-made slopes. The results of the analyses performed using the lower-bound parameters indicate that the slopes have minimum factors of safety in excess of 1.5 and 1.1 for static and seismic conditions, respectively.

5.1.3 Seismic Performance of Liner System

Overall stability analyses performed for the Eagle Mountain Landfill fully accounted for the landfill geometry and the properties of the liner system, waste, and cover system. An idealized cross section through the landfill, cut in a direction perpendicular to the landfill cover slope, is presented as Figure 12a. Inspection of this figure indicates the relative positions of the two surfaces that primarily influence the results of overall landfill stability analyses, i.e., surface passing along interfaces within the liner system at the base of the landfill and the final cover system over the top of the landfill. It is noted that the final landfill cover will be constructed with a uniform average inclination of 3.5H:1V and a maximum height from toe to crest of the waste slopes of approximately 1,400 ft (430 m). The configuration of sections cut through the landfill will vary because they are dependent on the relative positions of the landfill



A) PERPENDICULAR TO FINAL COVER SLOPE



B) PARALLEL TO FINAL COVER SLOPE

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FIGURE NO.:	12

cover and base. In particular, the thickness of waste in the landfill will be irregular because the position of the base of the landfill will generally reflect the irregular topography of the existing natural ground surface at the site.

The thickness of waste in the landfill will be variable, as depicted in Figure 12b, because the final cover has a uniform slope and the liner system foundation surface is irregular. The liner system foundation grade reflects the natural ridge lines and narrow valleys at the site. These factors suggest that two-dimensional (2-D) slope stability analyses, which assume that conditions are uniform in the direction not shown in 2-D sections, may not be representative of the 3-D conditions in all areas of the landfill. Three-dimensional (3-D) analyses were therefore performed as part of the stability evaluation.

A probabilistic seismic hazard assessment conducted for the Eagle Mountain Landfill site (Subsection 4.3.1) resulted in a peak horizontal ground acceleration at the site of 0.56 g based on prescriptive Subtitle D federal regulatory criteria. This prescriptive Subtitle D peak horizontal ground acceleration (i.e., 0.56 g) was used in the stability analyses of the liner system for the final landfill configuration.

The performance criterion for evaluation of landfill stability during the design earthquake is permanent displacement. Consolidated-undrained (CU) conditions, with consideration of the effect of cyclic loading, were assumed to apply for soil and interface shear strengths. At the Eagle Mountain Landfill, earthquake-induced permanent displacements could occur in the waste mass or liner system. The potential for permanent displacements in the waste mass will be accommodated by having a smooth upper surface on the high-density polyethylene (HDPE) geomembrane component of the side slope liner system. The HDPE geomembrane will be overlain by a geotextile cushion. The interface between the side-slope geomembrane and geotextile and between the cushion geotextile on the base and the overlying leachate collection system gravel represent "built in" slip layers in the event of significant seismically - induced shear stresses at the level of the liner system. Calculated

permanent displacements described subsequently may be considered to occur in the waste mass or at the slip layer. The maximum acceptable deformation is assumed to be 12 in. (300 mm), based on the magnitude of deformations considered acceptable in practice [Seed and Bonaparte, 1992; Anderson and Kavazanjian, 1995] and on the fact that the location of slippage has been designed to occur at a location that will not adversely impact the liner system.

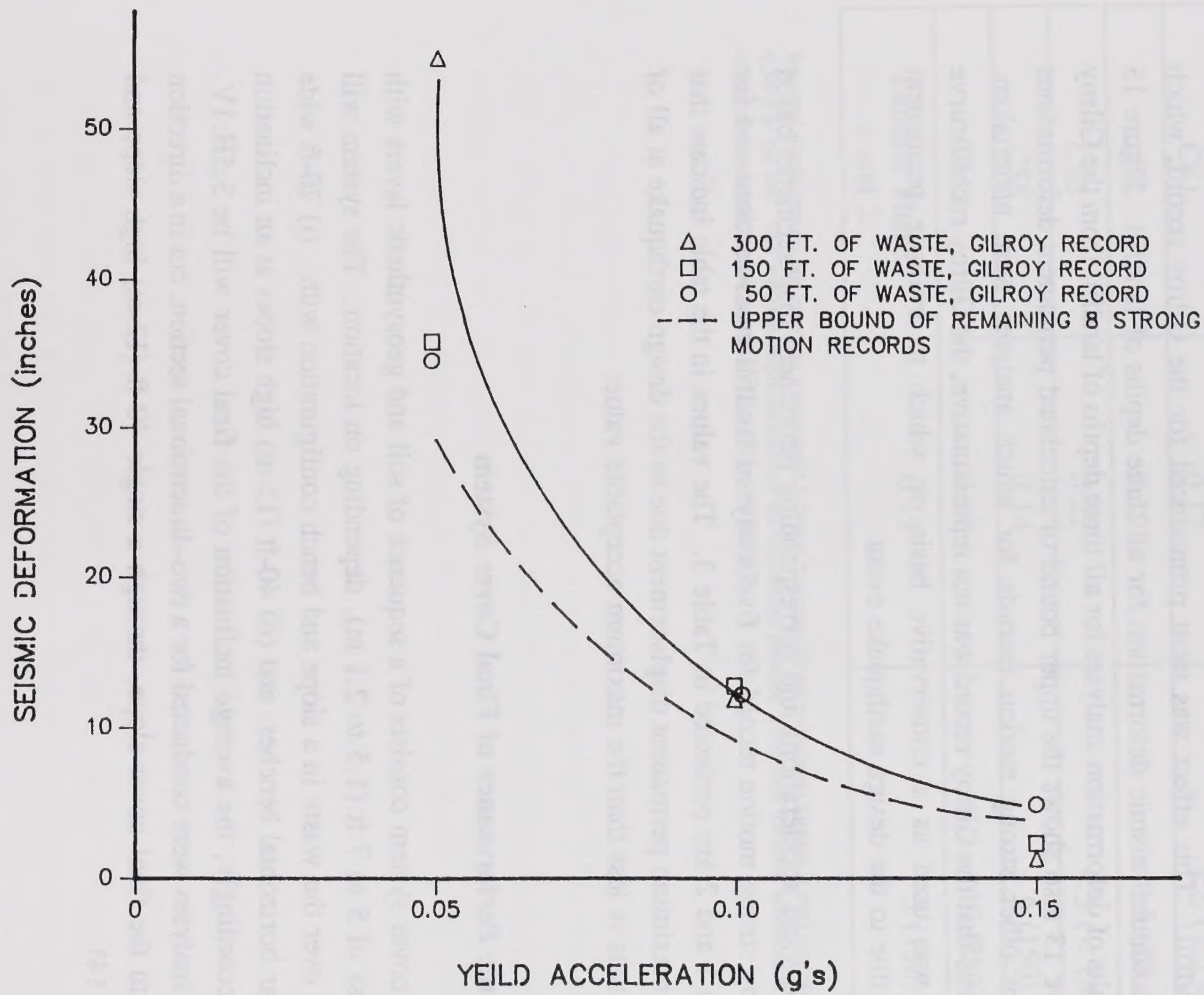
The seismic analyses were conducted to estimate permanent displacements that would occur during the design earthquake at certain areas within the final landfill configuration. Displacement analyses were performed using a procedure similar to that proposed by Makdisi and Seed [1977] for earth dams and commonly used in practice for seismic design of landfills [USEPA, 1995; Anderson and Kavazanjian, 1995]. The procedure involved four primary steps:

- selecting a time history of horizontal bedrock ground accelerations for the site under the design earthquake event;
- performing a site response analysis, wherein a time history of the average acceleration of a potential sliding mass is established from the time history of horizontal bedrock ground accelerations at the site;
- performing a pseudo-static slope stability analysis to obtain the pseudo-static horizontal yield acceleration, the pseudo-static acceleration at which the factor of safety equals 1.0, above which permanent slope displacements are assumed to occur; and
- performing a displacement analysis, wherein permanent displacements are calculated, using the method of Newmark [1965] and the aforementioned average acceleration time history and yield acceleration.

The calculated relationship between yield acceleration and permanent displacement during the design earthquake is presented in Figure 13. Permanent seismic displacements were calculated for the landfill mass for the design earthquake with a magnitude of 6.0 to 6.5 and a 0.56 g peak acceleration evaluated according to the prescriptive Subtitle D standards.

Since the landfill was founded upon rock, response analyses were not required to evaluate the effect of local soil conditions on the earthquake motions. However, response analyses were required to evaluate the response of the landfill mass to the seismic motions. One dimensional site response analyses were conducted using the computer program SHAKE [Schnabel et al, 1972]. Dynamic properties for the waste material were based upon the results of the field investigation and seismic response analysis of the Puente Hills Class III landfill [Earth Technology, 1988]. Response analyses were conducted for representative landfill depths of 50, 150, and 300 ft (15, 45, and 90 m). The average acceleration time histories for the landfill mass were then input to the computer program YSLIP-C [Elgamal et al, 1990; Yan, 1991] to calculate permanent seismic displacement as a function of yield acceleration. Analyses were initially conducted using the five acceleration time histories representative of the magnitude 6.0 to 6.5 design earthquake. Due to the relatively large displacements calculated using the Gilroy record from the 1979 Coyote Lake earthquake compared to the other four records, these analyses were supplemented with results from analyses using four additional strong motion records. These supplemental records, recorded at rock sites in recent earthquakes, included two from the 1987 magnitude 5.9 Whittier earthquake recorded at the Garvey Reservoir Control Building and two from the 1989 magnitude 7.1 Loma Prieta earthquake recorded at the University of California, Santa Cruz. Hence, deformation analyses were conducted for the three different depths of landfill using a total of nine strong motion records from five sites, encompassing four earthquakes of magnitude 5.9 to 7.1.

In all cases, accelerations within the center of the landfill mass and the average acceleration of the landfill mass showed attenuation with respect to the bedrock ground



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CALCULATED SEISMIC DEFORMATION OF LANDFILL

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DOCUMENT NO.:	MRC-065
FIGURE NO.:	13

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motion. However, due to a match between the "resonant" frequency of the landfill mass and the predominant frequency of the input motion, response analyses conducted using several of the records showed an increase in acceleration (amplification) at the top of the landfill. This effect was most pronounced for the Gilroy record, which yielded the maximum seismic deformation for all three depths of landfill. Figure 13 shows the results of deformation analyses for all three depths of landfill from the Gilroy record. Figure 13 also shows the upper bound of calculated permanent deformations from the eight other strong motion records for which analyses were undertaken. Despite concerns that the Gilroy record was not representative, the Gilroy record curve in Figure 13 was used as a conservative basis on which to evaluate permanent displacements due to the design earthquake event.

Calculated yield accelerations and corresponding permanent displacements based upon the Gilroy strong motion record for five analyzed landfill cross-sections and for landfill Phases 1 and 2 are presented in Table 3. The values in the table indicate that the calculated maximum permanent displacement due to the design earthquake at all of the analyzed areas is less than the maximum acceptable value.

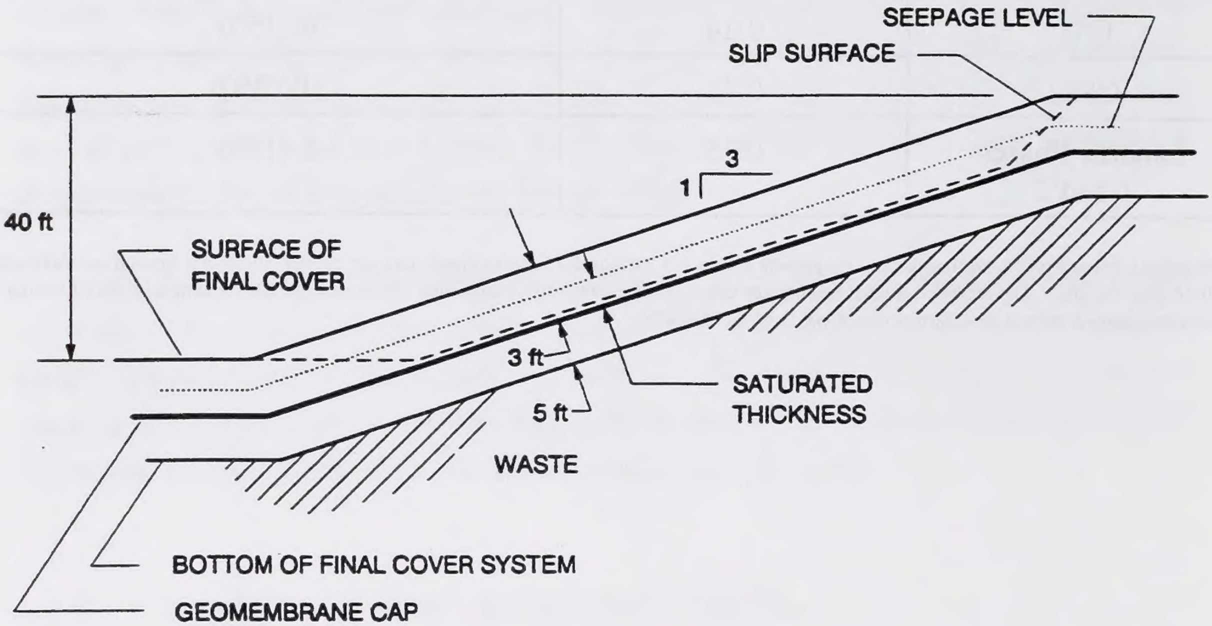
5.1.4 Seismic Performance of Final Cover System

The final cover system consists of a sequence of soil and geosynthetic layers with a total thickness of 5 to 7 ft (1.5 to 2.1 m), depending on location. The system will be constructed over the waste in a slope and bench configuration with: (i) 20-ft wide (6-m wide) near-horizontal benches; and (ii) 40-ft (12-m) high slopes at an inclination of 3H:1V. Accordingly, the average inclination of the final cover will be 3.5H:1V. Slope stability analyses were conducted for a two-dimensional section, cut in a direction perpendicular to the final cover slope, through a single 40-ft (12-m) high slope and bench (Figure 14).

Table 3. Seismic Displacement Analysis, Final Landfill Configuration at Eagle Mountain Landfill

SECTION ANALYZED	YIELD ACCELERATION, g	PERMANENT DISPLACEMENT FOR DESIGN EARTHQUAKE[(1)], in. (mm)
CS1	0.17	<5 (<130)
CS2	0.12	8.5 (220)
CS5	0.22	<5 (<130)
CS8	0.14	6 (150)
CS12	0.11	10 (250)
Landfill Phases 1 and 2	0.15	5 (130)

(1) Reported displacements are based on a magnitude 6.0 to 6.5 earthquake (approximate) causing a peak horizontal ground acceleration of 0.56 g at the site. The reported displacements are the maximums obtained using nine different acceleration time histories meeting the aforementioned criteria (see Subsection 8.6.6.2 of the ROWD).



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FINAL COVER SYSTEM AND SLIP SUFACE

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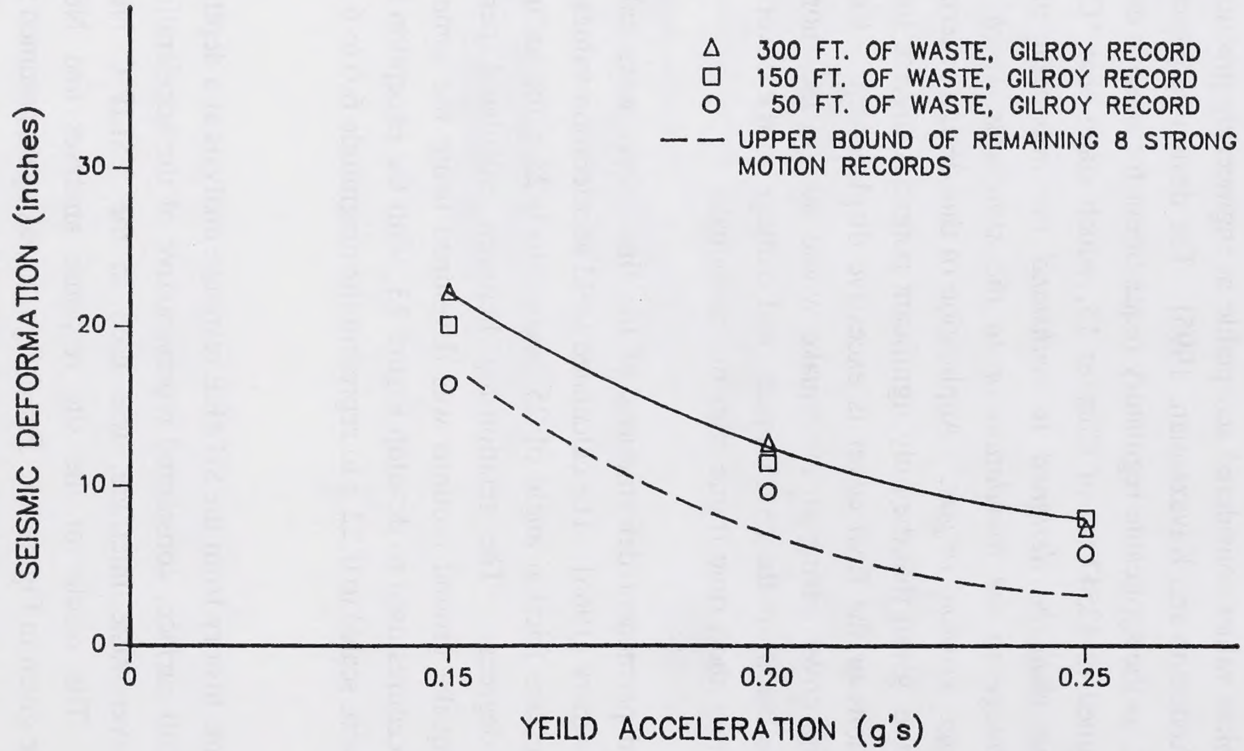
FIGURE NO.:	14

The performance of the final cover during an earthquake was evaluated using a maximum acceptable value of permanent displacement. The maximum allowable permanent displacement due to the design earthquake was established as 12 in. (300 mm), based on typical values considered acceptable in engineering practice [Seed and Bonaparte, 1992; Anderson and Kavazanjian, 1995]. The design earthquake was assumed to be the MPE, as the applicable regulatory requirement for seismic design of the final cover is contained in §2547.(a) of Chapter 15, which states that "*Class III waste management unit shall be designed to withstand the maximum probable earthquake without damage to the foundation or to the structures which control leachate, surface drainage, erosion, or gas.*" Application of this design criteria to the final cover is conservative, given that the only significant potential adverse impact of earthquake ground motions or the final cover is excessive displacement. Excessive displacement of the final cover during an earthquake would not, in the short term, adversely impact human health or the environment, and damage to the cover can be repaired within a relatively short time frame after the earthquake.

Seismically-induced permanent deformations of the final cover were calculated using the method of Newmark [1965]. The calculated yield acceleration values ranged from 0.15 g for an interface friction angle of 25 degrees to 0.23 g for an interface friction angle of 30 degrees. The relationship between calculated permanent displacement and earthquake ground motions was developed using the same strong motion records and procedures used to develop Figure 13, with the exception that the strong motion records were scaled to 0.22 g to represent the magnitude 6.0 to 6.5 near-field MPE event.

The acceleration time history from the SHAKE response analysis at a depth of 5 ft (1.5 m) below the landfill surface, considered representative of the acceleration time history at the final cover-waste interface, was used in the YSLIP-C Newmark deformation analyses. The results of the site response analyses and Newmark deformation analyses are given in Figure 15. For design, it was again assumed that the Gilroy record applied to the Eagle Mountain Landfill. The use of this record is



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CALCULATED SEISMIC DEFORMATION OF FINAL COVER	PROJECT NO.: CE4030-02 DOCUMENT NO.: MRC-065 FIGURE NO.: 15

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considered conservative based on the fact that permanent deformations associated with eight other strong motion records are significantly less than those associated with the Gilroy record.

Permanent deformations for the final cover of the Eagle Mountain Landfill under the design earthquake event were estimated as follows: (i) 22 in. (550 mm) for a yield acceleration of 0.15 g; and (ii) 9.5 in. (240 mm) for a yield acceleration of 0.23 g. These results and the curve presented in Figure 15, indicate that the final cover for the Eagle Mountain Landfill must be constructed to have a yield acceleration of at least 0.21 g to obtain a calculated permanent seismic deformation of less than 12 in. (300 mm) for the final cover. The construction specifications for the landfill must contain material property requirements designed to satisfy these criteria.

5.2 Analyses Performed for ROWD-SV1

Additional studies related to seismic slope stability at the Eagle Mountain Landfill were performed during preparation of the ROWD-SV1 [GeoSyntec 1993a]. Specifically, these studies consisted of analyses of permanent landfill deformations due to a far-field MPE event on the San Andreas fault performed in response to DWR comments (see Subsection 4.3.2 of this report). Table 4 summarizes DWR comments on seismic design at the Eagle Mountain Landfill and the disposition of these comments by MRC and the RWQCB.

The analyses of the potential for permanent landfill deformations due to a large earthquake on the San Andreas fault were based on a peak horizontal acceleration in bedrock of 0.16 g. The use of this peak acceleration is conservative, since, as described in Subsection 4.3.2, the acceleration is based on a MCE event. Seismic deformation analyses were conducted for the four strong motion records selected as representative of an earthquake involving the segment of the San Andreas fault closest to the site described in Subsection 4.3.3.

Table 4. DWR Comments On Slope Stability Analysis and Comment Resolution

DWR COMMENT[(1)]	COMMENT RESOLUTION
1. A final design report should be prepared for each subphase of landfill development and submitted to the RWQCB prior to the start of construction of that subphase. The report should demonstrate how minimum acceptable factors of safety are achieved for that subphase.	1. See WDR Specification 47. which requires final construction design plans and specifications at least 120 days prior to initiation of construction of each subphase of the landfill. Minimum acceptable slope stability factors of safety are specified.
2. Good construction supervision is needed to assure that design assumptions are satisfied.	2. See WDR Specification 47.e. entitled "Construction Quality Assurance - Quality Control" and 49. These Specifications give detailed requirements for quality control and quality assurance during construction of the Eagle Mountain Landfill.
3. DWR recommends that slightly different parameters be used to characterize the shear strength of municipal solid waste than strength parameters used in the ROWD analyses.	3. DWR concluded that the differences in shear strength parameters between DWR and ROWD resulted in differences in calculated slope stability factors of safety of only 2 to 3 percent. This small difference in calculation results is negligible.
4. Prior to construction, interface shear strengths tests should be performed using the specific geosynthetic materials specified for construction.	4. See WDR Specification 47.e. which contains requirements for performing interface shear strength tests using the "specific geosynthetic materials specified for different elements of the liner."
5. An equivalent shear strength increase of no more than 3 degrees should be used to account for dilatory effects of the slope and bench configuration of the landfill side slopes.	5. See WDR Specification 47.a.3. which states "a small increase in shear strength not greater than represented by a dilation angle of 3° may be used to account for the kinematic constraints imposed by side slope benches."
6. A detailed fill plan should be developed for each subphase of landfill development. The fill plan should detail the limits of acceptable interim geometries for all locations of the landfill subphase.	6. See WDR Specification 47.d. entitled "Detailed Fill Plan," which requires preparation of a detailed fill plan in accordance with the DWR comment.
7. Three-dimensional geometry effects should be evaluated for interim and final slope conditions for each landfill subphase.	7. See WDR Specification 47.b.4. which requires consideration of three-dimensional slope stability effects in accordance with the DWR comments.

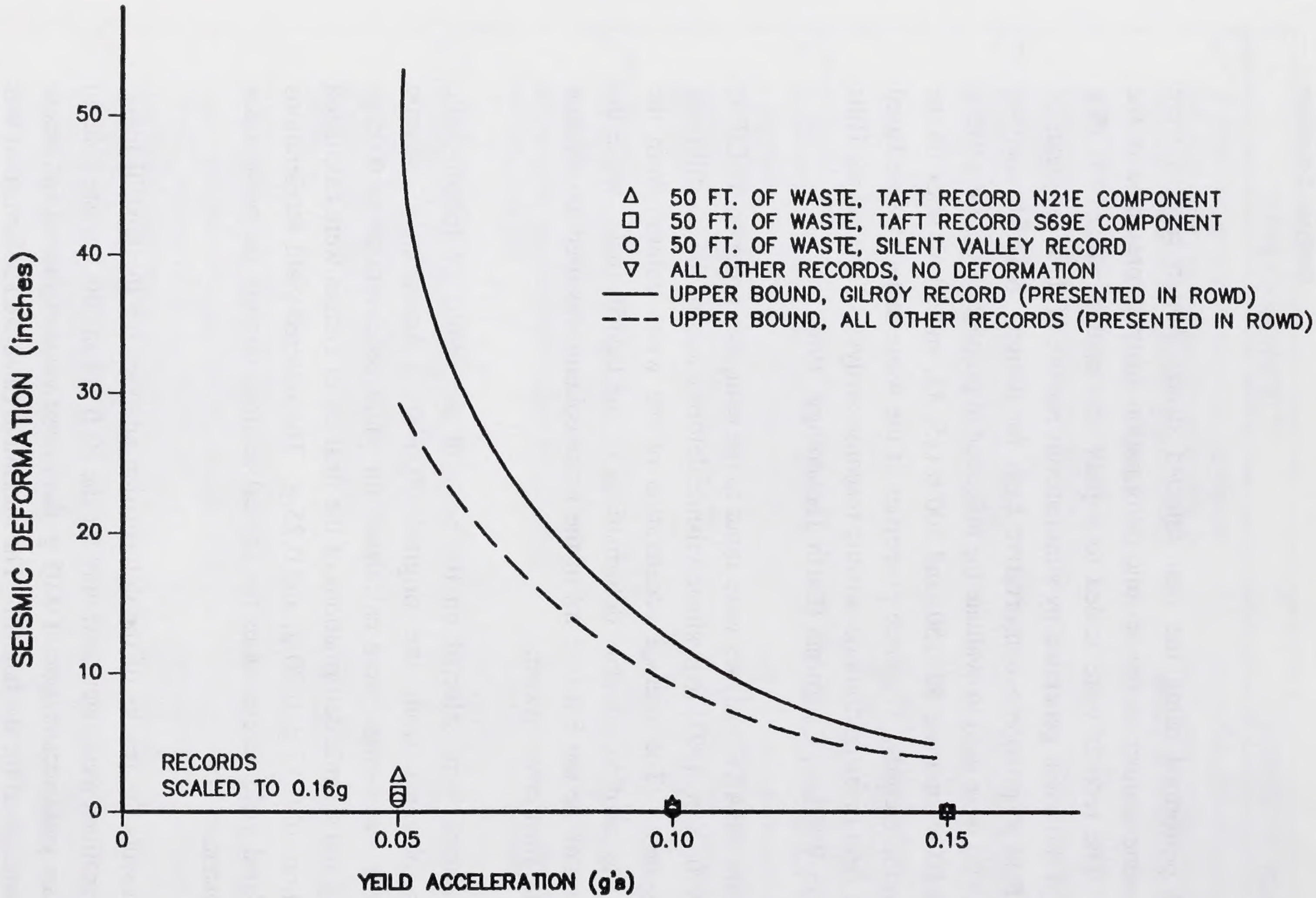
(1) DWR Comments are summarized from a 29 October 1993 letter from Mr. Raphael A. Torres of DWR to Ms. Charlene Herbst of CIWMB.

The analyses performed using the four selected strong motion records were conducted in the same manner as the seismic deformation analyses presented in the original ROWD. The records were scaled to a peak acceleration value of 0.16 g associated with a M 8.0 event generated by simultaneous rupture of three segments of the San Andreas fault to provide a conservative basis for design. SHAKE analyses [Schnabel et al., 1972] were used to evaluate the influence of propagation of the seismic waves through a solid waste mass 50, 150, and 300 ft (15, 45, and 90 m) thick on the bedrock strong motion records. Dynamic properties of the waste material were based on the results of a field investigation and seismic response analysis of the Puente Hills Class III Landfill in Whittier, California [Earth Technology, 1988].

Results from the SHAKE analyses were input to the computer program YSLIP-C [Elgamal et al., 1990; Yan, 1991] to evaluate seismic deformations of the landfill mass and final cover system. The average acceleration of the waste column from the SHAKE analysis was used to calculate deformations of the landfill mass, while the average acceleration of the top 5 ft (1.5 m) of the waste column was used to calculate deformations of the final cover system.

Yield accelerations were selected on the basis of the results of pseudo-static stability analyses obtained from the original ROWD. Accordingly, seismic deformations of the waste mass were calculated for yield accelerations of 0.05 g, 0.10 g, and 0.15 g and seismic deformations of the final cover system were calculated for yield accelerations of 0.15 g, 0.20 g, and 0.25 g. The selected yield accelerations bracket the calculated yield accelerations for critical sections through the waste mass and final cover system.

Figure 16 presents the results of the deformation analyses for the landfill mass. Appreciable deformations were calculated only for the 50 ft (15 m) thick waste column and for a waste mass yield acceleration of 0.05 g, the lowest value evaluated and below the lowest value anticipated for the landfill. The maximum calculated deformation was



EAGLE MOUNTAIN LANDFILL AND RECYCLING CENTER RIVERSIDE COUNTY, CALIFORNIA PREPARED FOR: MINE RECLAMATION CORPORATION	GEOSYNTEC CONSULTANTS HUNTINGTON BEACH, CALIFORNIA
CALCULATED SEISMIC DEFORMATION OF LANDFILL	PROJECT NO.: CE4030-11 DOCUMENT NO.: MRC-065 FIGURE NO.: 16

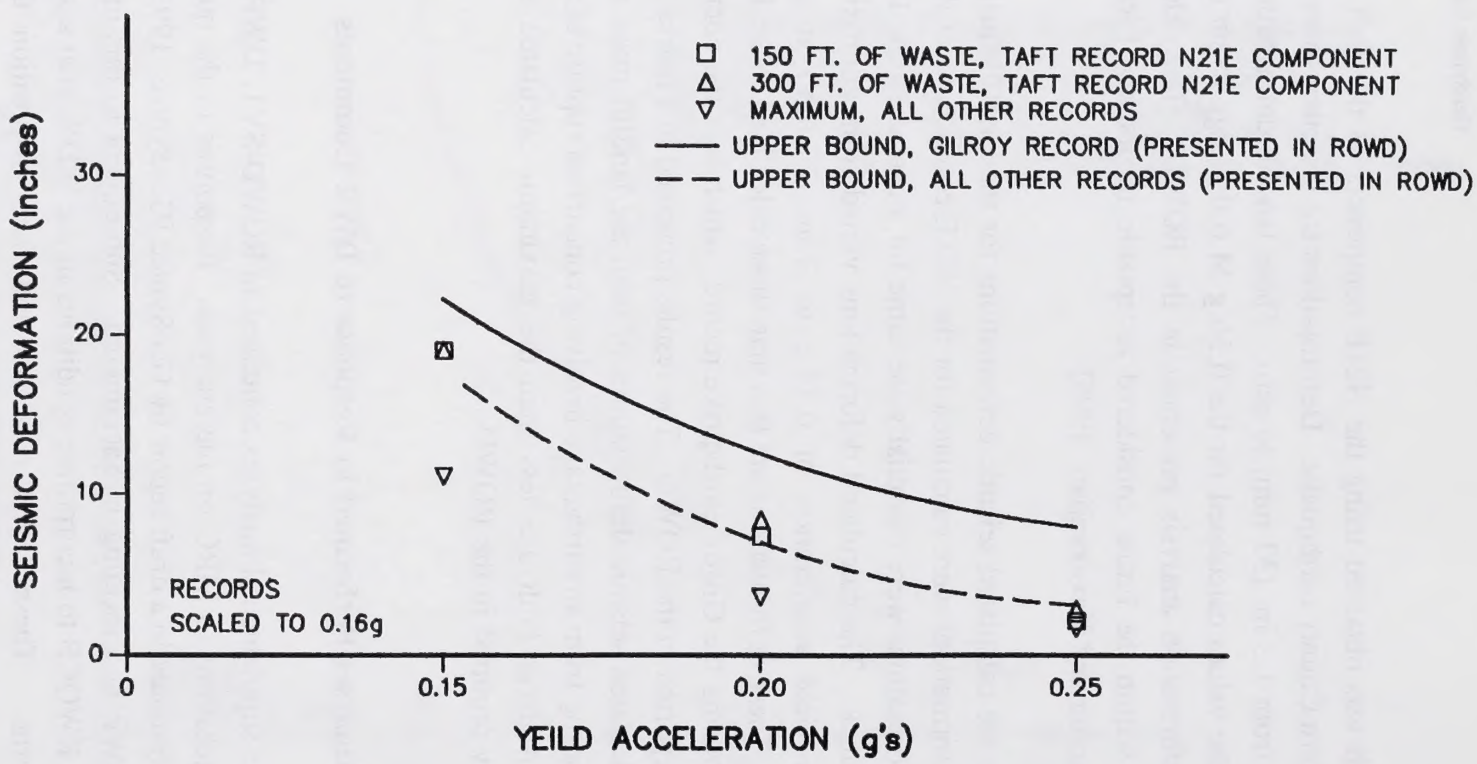
DWG: 4030E 9306081625 LP

2.6 in. (66 mm), which was obtained using the N21E component of the Taft record from the 1952 M 7.7 Kern County earthquake. Deformations for the other three strong motion records ranged from 1.3 in. (33 mm) to zero. These landfill deformations are significantly less than the values calculated for the 0.56 g M 6.0 design event used in the landfill seismic deformation analysis presented in the ROWD. The calculated deformations are well within the limits considered acceptable in practice [Seed and Bonaparte, 1992; Anderson and Kavazanjian, 1995].

Figure 17 presents the calculated seismic deformations for the landfill final cover system. The largest deformations were calculated for the N21E component of the Taft record. Calculated deformations were essentially the same for waste columns 150 and 300 ft (45 and 90 m) thick. The calculated deformations varied from approximately 18 in. (460 mm) at a yield acceleration of 0.15 g to 3 in. (76 mm) at a yield acceleration of 0.25 g. These deformations are less than those calculated in the ROWD (Volume 1, Section B) using the Gilroy earthquake record, which was the controlling strong motion record reported in the ROWD. The results presented in Figures 16 and 17 indicate that the calculated seismic deformations of both the landfill mass and the final cover system, resulting from an earthquake involving concurrent rupture of several segments of the San Andreas fault are less than the maximum calculated seismic deformations previously reported in the ROWD.

5.2.1 Additional Analyses Performed in Response to DWR Comments

After review of the supplemental analyses contained in ROWD-SV1, DWR posed a series of additional questions to MRC on the analyses. Responses to the questions raised by DWR were presented in a draft report by GeoSyntec [GeoSyntec, 1993b] and were discussed with DWR at a meeting in Sacramento. Subsequent to this meeting, DWR worked with the RWQCB to incorporate conditions in the WDRs that addressed their remaining concerns. These DWR concerns and their disposition through conditions in the WDRs are summarized in Table 4.



EAGLE MOUNTAIN
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CALCULATED SEISMIC
DEFORMATION OF FINAL COVER

PROJECT NO.:	CE4030-11
DOCUMENT NO.:	MRC-065
FIGURE NO.:	17

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This section of the report summarizes the results of additional seismic deformation analyses performed during preparation of the draft responses to DWR. The purpose of the additional analyses was to evaluate the degree of conservatism inherent in the seismic deformation analyses presented in the ROWD and ROWD-SV1. The analyses performed during preparation of the ROWD and ROWD-SV1 are conservative for two reasons. First, the analyses do not account for the interaction between geosynthetic liner system and cover system components, adjacent soil layers and waste. Seismically-induced slippage along low shear resistance interfaces results in a "frictional base isolation" effect that will reduce the intensity of shaking within the waste in comparison to the intensity if no slip were to occur. Second, the SHAKE method of analysis [Schnabel et al., 1972] generates unrealistically high ground surface accelerations when the peak acceleration of the input motions exceed 0.4 g due to the linear elastic nature of the SHAKE analyses.

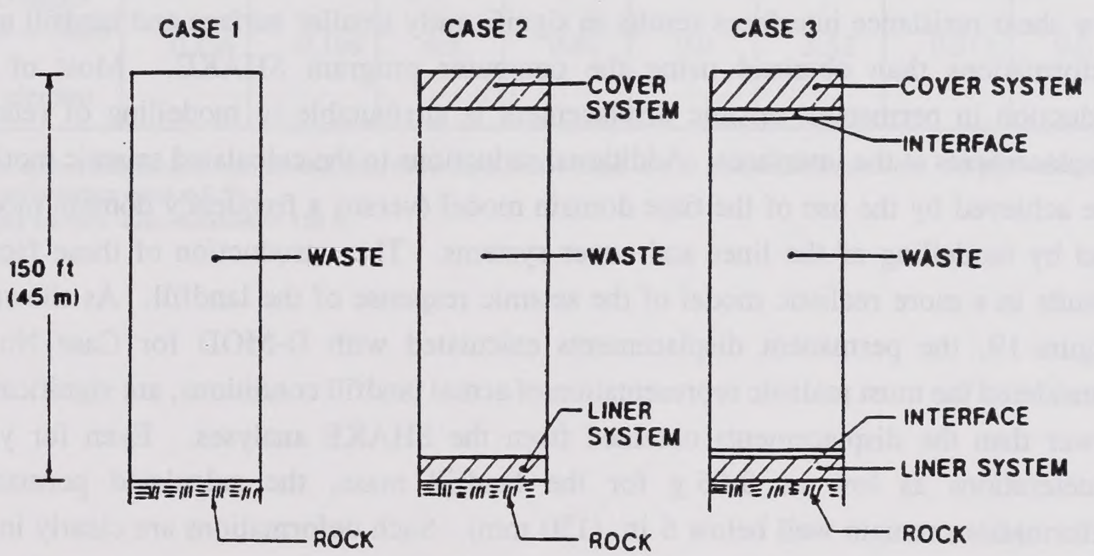
To evaluate the conservatism inherent to the SHAKE analyses, additional analyses of the seismic response to the landfill were performed using a modified version of DESRA2 [Lee and Finn, 1978], a computer program for nonlinear, one-dimensional, time-domain elasto-plastic seismic site response analyses. SHAKE analyses employ simplifying assumptions that the equivalent elastic moduli and fraction of critical damping of the various site materials are constant for the duration of the earthquake. These values are adjusted in an iterative manner to yield "strain compatible" final values based upon 65 percent of the maximum shear strain computed in the analysis. While this approach yields peak stresses and strains, it does not represent the actual load-deformation response of the waste mass. In DESRA2, the actual stress-strain behavior of the waste material is modelled. This allows the modulus of the waste to vary during the earthquake in a realistic manner. Furthermore, an element (soil or waste) in the profile can be allowed to yield, providing DESRA2 with the ability to model slip at low shear resistance interfaces. The hysteretic damping in DESRA2 is not an independent parameter, but is a function of the stress-strain response of the material and will also vary over the duration of the earthquake.

DESRA2 employs the Kondner and Zelasko [1963] (K-Z) hyperbolic stress-strain constitutive model to represent the "backbone curve" for the hysteresis loops formed by cyclic loading of soil or waste. The additional seismic response analyses employed a modification of DESRA2 called D-MOD [Matasovic, 1993]. D-MOD incorporated a modified Kondner and Zelasko (M-K-Z) constitutive model for the backbone curve [Matasović and Vucetic, 1993]. The M-K-Z model allows the user to obtain a better fit than the M-K model between hysteresis loops predicted by the model and the modulus reduction and damping curves used in the SHAKE analyses.

Analyses were performed using D-MOD for comparison with the results of the SHAKE analyses presented in the ROWD and ROWD-SV1. Three different sets of D-MOD analyses were performed: each succeeding set of analyses progressively introduced a more sophisticated representation of the landfill. The D-MOD analyses included: (i) analyses of waste on top of rock with no liner or cover system layers; (ii) analyses using layers representing landfill liner and cover system soils, but with no slip at these levels; and (iii) analyses including liner and cover system soil layers and allowing slip at low shear resistance interfaces. The critical interface shear resistances for the liner and cover systems were based on a range of yield accelerations. Therefore, a separate analysis was required for each combination of liner system yield acceleration and cover system yield acceleration considered in the analyses. The stratigraphic columns for the three cases analyzed using D-MOD are presented in Figure 18. Case No. 1, (i.e., waste on top of rock with no liner or cover system) corresponds to the profile used in the SHAKE analyses.

D-MOD analyses were performed for a 150 ft (45 m) thickness of waste and for the two most critical strong motion records identified in the SHAKE analyses presented in the ROWD and ROWD-SV1: the Gilroy record scaled to 0.56 g, representative of a nearby earthquake corresponding to the prescriptive Subtitle D federal seismic design criterion, and the Kern-Taft N21E record scaled to 0.16 g, representative of a San Andreas event corresponding to the far-field MPE evaluated in accordance with

STRATIGRAPHIC COLUMNS USED FOR D-MOD ANALYSES



NOTE: THICKNESS OF LINER AND COVER SYSTEMS ARE EXAGGERATED FOR CLARITY

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FIGURE NO.	18
PROJECT NO.	CE4030-11
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California seismic design criterion. Key parameters summarizing the results of the analysis are presented in Tables 5 and 6. Previously reported SHAKE analysis results are included in these tables for comparison purposes. Seismic deformations calculated from the results of the D-MOD response analyses are also provided in Tables 4 and 5. Seismic deformations of the waste mass based upon results for D-MOD Case No. 3, where slip is allowed at the low shear resistance interfaces, are compared to the results calculated based upon the SHAKE analyses in Figure 19 for the liner system and Figure 20 for the cover system.

Results of the D-MOD analyses show that the use of a truly nonlinear time-domain seismic response analysis that accounts for the potential for relative displacements at low shear resistance interfaces results in significantly smaller surface and landfill mass deformations than obtained using the computer program SHAKE. Most of the reduction in permanent seismic displacement is attributable to modelling of relative displacements at the interfaces. Additional reductions in the calculated seismic motions are achieved by the use of the time domain model (versus a frequency domain model) and by modelling of the liner and cover systems. The introduction of these factors results in a more realistic model of the seismic response of the landfill. As shown in Figure 19, the permanent displacements calculated with D-MOD for Case No. 3, considered the most realistic representation of actual landfill conditions, are significantly lower than the displacements obtained from the SHAKE analyses. Even for yield accelerations as low as 0.06 g for the landfill mass, the calculated permanent deformations remain well below 6 in. (150 mm). Such deformations are clearly in the acceptable range. This conclusion is valid both for design events corresponding to California regulations and for design events corresponding to Federal requirements.

Table 5. Results of Seismic Response and Displacement Analyses, Gilroy Record/a_{MAX} = 0.56g, Eagle Mountain Landfill

CASE NUMBER	PEAK ACCELERATION		DEFORMATION (in.)[2]					
	Ground Surface (g)	Landfill Mass (g)	Landfill			Cover		
			k_y = 0.05	k_y = 0.10	k_y = 0.15	k_y = 0.15	k_y = 0.20	k_y = 0.25
SHAKE (all waste)	1.22	0.289	35.9	13.0	5.6	22.1[1]	12.6[1]	8.4[1]
1: D-MOD (all waste)	0.510	0.268	28.6	12.1	5.1	24.41	16.21	10.22
2: D-MOD (cover + base)	0.476	0.259	25.1	9.8	3.5	20.48	12.88	7.50
3: D-MOD (cover + base) slip element	0.456	0.106	6.5	0.01	0.0	3.52	0.517	0.0

(1) Cover system deformations from SHAKE analysis for input motion scaled to 0.22 g maximum acceleration with peak acceleration at landfill surface equal to 0.93 g.
(2) Results are for a waste thickness of 150 ft.

Table 6. Results of Seismic Response and Displacement Analyses, Kern-Taft N21E Record/a_{MAX} = 0.16g, Eagle Mountain Landfill

CASE NUMBER	PEAK ACCELERATION		DEFORMATION (in.)[1]					
			Landfill			Cover		
	Ground Surface (g)	Landfill Mass (g)	k_y = 0.05	k_y = 0.10	k_y = 0.15	k_y = 0.15	k_y = 0.20	k_y = 0.25
SHAKE (all waste)	0.506	0.11	0.433	0.0	0.0	19.1	7.5	2.3
1: D-MOD (all waste)	0.149	0.081	0.389	0.0	0.0	0.0	0.0	0.0
2: D-MOD (cover + base)	0.149	0.079	0.160	0.0	0.0	0.0	0.0	0.0
3: D-MOD (cover + base) slip element	0.150	0.077	0.186	0.0	0.0	0.0	0.0	0.0

[1] Results are for a waste thickness of 150 ft.

EAGLE MOUNTAIN LANDFILL
CALCULATED SEISMIC DEFORMATION OF LANDFILL

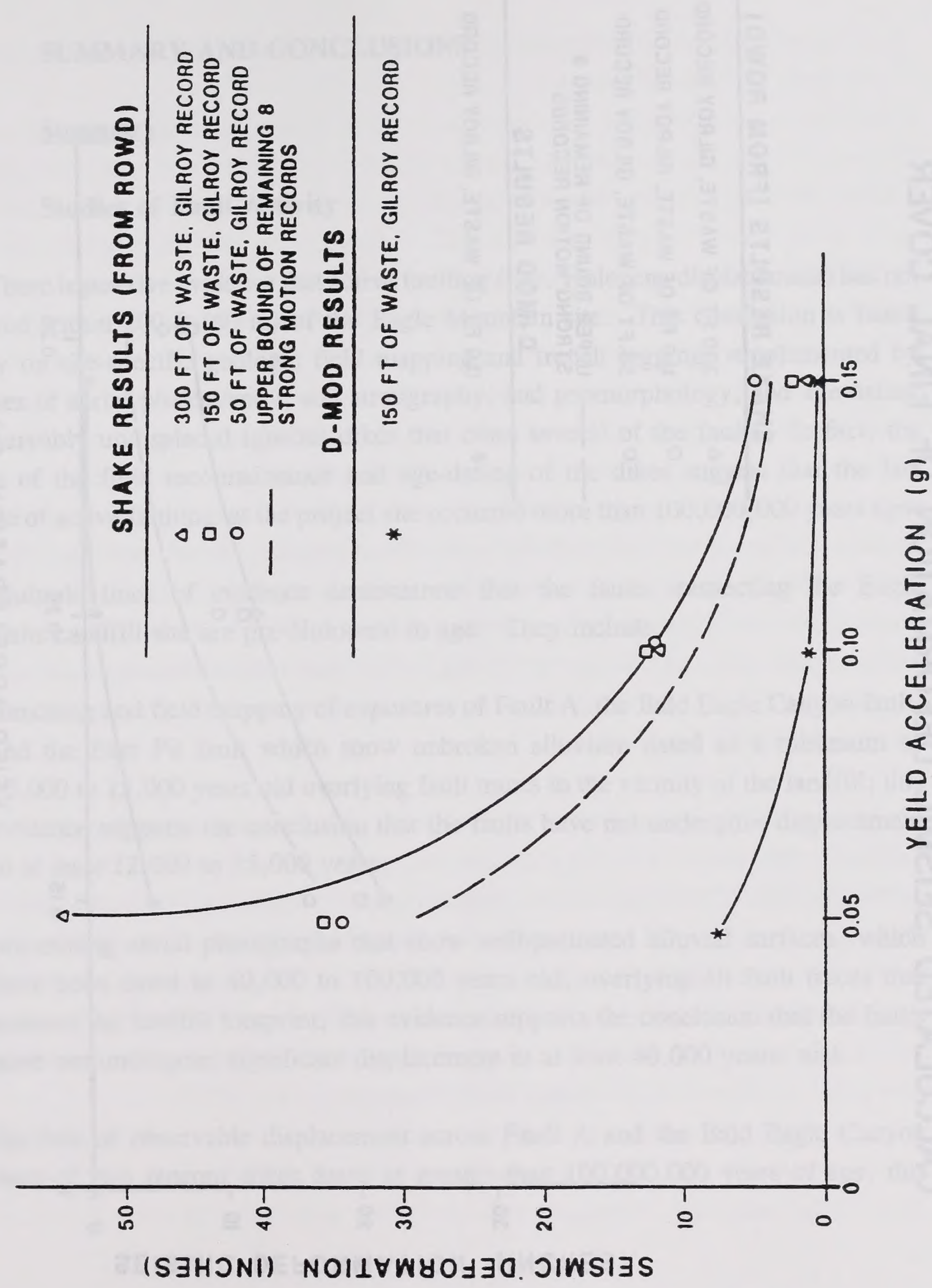

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FIGURE NO.	19
PROJECT NO.	CE4030-11
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EAGLE MOUNTAIN LANDFILL
CALCULATED SEISMIC DEFORMATION OF FINAL COVER

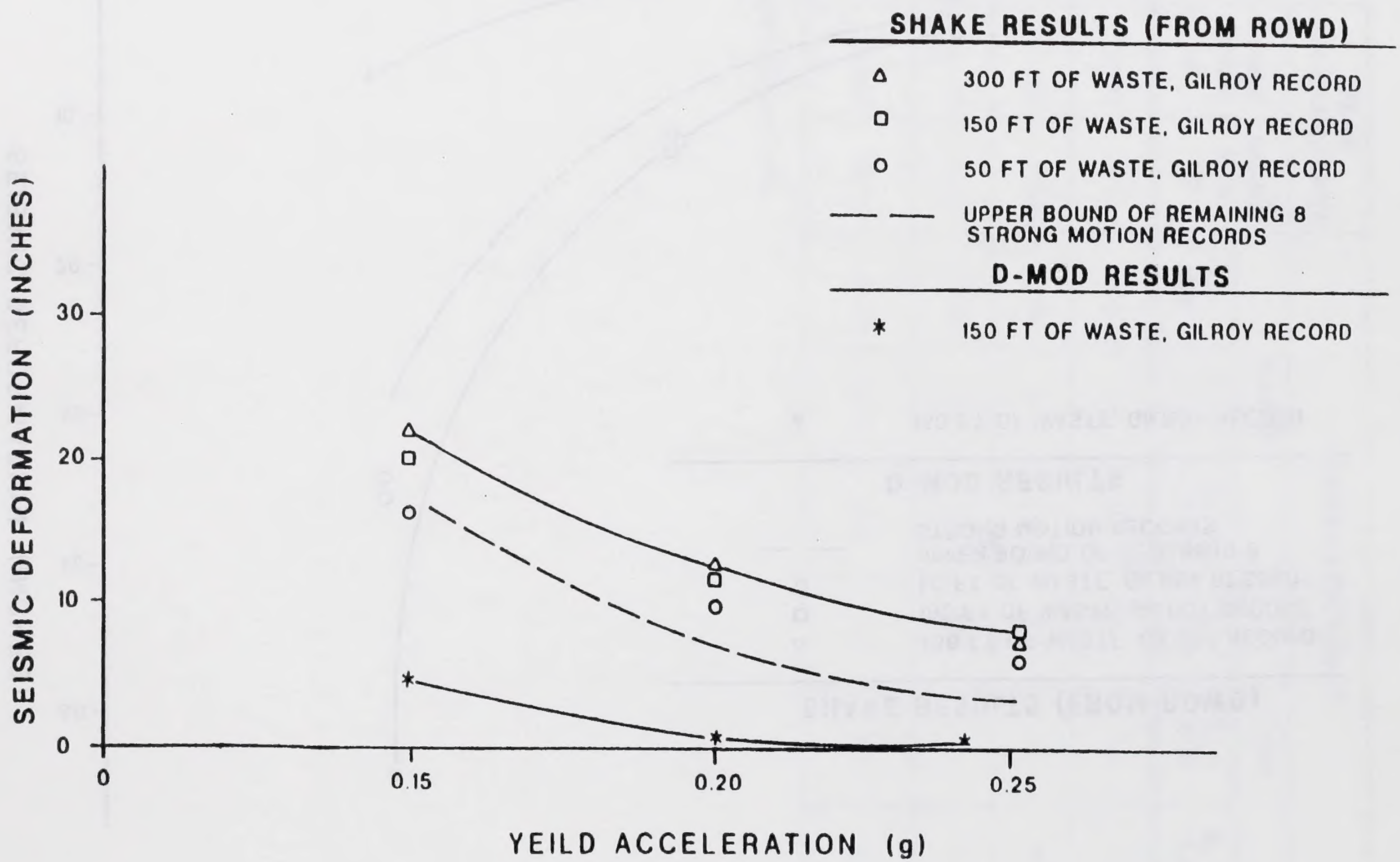

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FIGURE NO.	20
PROJECT NO.	CE4030-11
DOCUMENT NO.	GA930681
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6. SUMMARY AND CONCLUSIONS

6.1 Summary

6.1.1 Studies of Fault Activity

There is positive evidence that active faulting (i.e., Holocene displacement) has not occurred within 200 ft (60 m) of the Eagle Mountain site. This conclusion is based mainly on site-specific geologic field mapping and trench logging, supplemented by analyses of aerial photography, soil stratigraphy, and geomorphology, and age-dating of observably undisplaced igneous dikes that cross several of the faults. In fact, the results of the field reconnaissance and age-dating of the dikes suggest that the last episode of active faulting at the project site occurred more than 100,000,000 years ago.

Multiple lines of evidence demonstrate that the faults transecting the Eagle Mountain Landfill site are pre-Holocene in age. They include:

- trenching and field mapping of exposures of Fault A, the Bald Eagle Canyon fault, and the East Pit fault which show unbroken alluvium dated as a minimum of 12,000 to 15,000 years old overlying fault traces in the vicinity of the landfill; this evidence supports the conclusion that the faults have not undergone displacement in at least 12,000 to 15,000 years;

- pre-mining aerial photographs that show well-patinated alluvial surfaces, which have been dated as 40,000 to 100,000 years old, overlying all fault traces that transect the landfill footprint; this evidence supports the conclusion that the faults have not undergone significant displacement in at least 40,000 years; and

- the lack of observable displacement across Fault A and the Bald Eagle Canyon fault of two igneous dikes dated at greater than 100,000,000 years of age; this

evidence supports the conclusion that displacement along these two faults predates at least 100,000,000 years.

6.1.2 Strong Shaking Studies

Seismic hazard analyses were performed for the Eagle Mountain Landfill in accordance with both the prescriptive approach provided in the Subtitle D regulations and the alternative site-specific approach required by California regulations. For the prescriptive Subtitle D approach, the MHA was evaluated from the most recent version of the Algermissen maps published by USGS. A site-specific probabilistic analysis was performed in conjunction the prescriptive Subtitle D approach to validate the MHA interpolated from the Algermissen map and to establish an appropriate earthquake magnitude to associate with the MHA. Results of the analysis indicate that the design event evaluated in accordance with the prescriptive Subtitle D regulations is a magnitude 6.0 to 6.5 event approximately 5 miles (8 km) from the site generating a free field bedrock PGA at the site of 0.56 g. This event is attributed to the random seismicity assigned to the Southeast Transverse Ranges seismo-tectonic province or to rupture of the Blue Cut Fault.

In the alternative approach to evaluating the design earthquake required by California regulations, a site-specific analysis was performed to establish the MPE in accordance with CDMG guidelines. Results of this analysis indicate that both a near-field event, consisting of a magnitude 6.0 event in the Southeast Transverse Ranges source zone generating a free-field bedrock PGA of 0.22 g at the site, and a far-field event, consisting of a magnitude 7.8 event on multiple segments of the San Andreas fault at a distance of 33 miles (53 km) generating a free field PGA of 0.14 g at the site, need to be considered in evaluating landfill response to the MPE.

6.1.3 Performance Analyses

Several different categories of seismic slope stability analyses were performed to confirm that the shear strength properties of the natural and engineered materials included in the landfill design, coupled with the proposed geometry of the landfill, result in adequate seismic performance. The analyses included pseudo-static slope stability of natural and man-made slopes, and deformation analyses of the liner and final cover systems for the proposed landfill.

For the deformation analyses, suites of representative time histories were assigned to both the prescriptive Subtitle D and alternative California design events. Landfill performance analyses were conducted using selected time histories to establish minimum acceptable interface shear strength values for inclusion in construction specifications for selection of appropriate materials for construction of the landfill. Calculated permanent displacement of the landfill for the design seismic events is less than 12 in (300 mm). Engineered components of the landfill are designed to accommodate ground motions and the calculated levels of permanent displacement without loss of serviceability.

6.2 Conclusions

The proposed Eagle Mountain Landfill meets and exceeds both State and Federal design standards for municipal solid waste landfill facilities. The site is located at the eastern edge of the zone of historic seismic activity in southern California. Local and regional geological studies provide positive evidence that no Holocene-age faults exist at or in the vicinity of the site.

The stability of the landfill was evaluated for strong ground motions corresponding to both prescriptive Subtitle D standards and alternative California standards. Design earthquakes corresponding to these standards were evaluated on a conservative basis.

The response of the landfill to these ground motions was evaluated on a conservative basis using equivalent-linear seismic response analyses. Results of the analyses yield permanent seismic deformations below the maximum values considered acceptable in practice. These analyses indicate that the landfill design not only satisfies both State and Federal regulations, but also possess a high degree of seismic stability and safety.

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Appendix H-2
Assessment of Landfill Performance
in Recent Earthquakes

Prepared for

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Palm Springs, California 92262

ASSESSMENT OF LANDFILL PERFORMANCE IN RECENT EARTHQUAKES

EAGLE MOUNTAIN LANDFILL AND RECYCLING CENTER RIVERSIDE COUNTY, CALIFORNIA

Prepared by

GeoSyntec Consultants

2100 Main Street, Suite 150
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Project Number GE3586-18

May 1996

EXECUTIVE SUMMARY

At the request of the Mine Reclamation Corporation (MRC), GeoSyntec Consultants (GeoSyntec) has reviewed and summarized observations of landfill performance in recent earthquakes and assessed the implication of these observations on the design of the proposed Eagle Mountain Landfill and Recycling Center (Eagle Mountain Landfill) in northeastern Riverside County, California. Seismic design of the Eagle Mountain Landfill is described in the Report of Waste Discharge (ROWD) and a supplemental volume, ROWD-SV1. These documents show the project site to be beyond the area of major historic seismic activity in southern California, in an area of relatively low seismicity that is not subject to active faulting. These documents also show that the landfill is designed to resist earthquake-induced strong ground motions established in accordance with both State and Federal regulations without impairment to the landfill containment systems. These State and Federal standards for seismic design of landfills are significantly more stringent than seismic standards for design of commercial and residential structures and are comparable to modern design standards for highway bridges and other important facilities.

Observations of the performance of landfills in recent earthquakes indicate that the evaluation of the seismic performance of the landfill described in the ROWD and ROWD-SV1 is based on conservative design assumptions and parameters. The results of the seismic performance analyses indicate that the proposed design for the Eagle Mountain Landfill provides a high level of protection against seismic upset. This finding is consistent with the excellent history of performance of solid waste landfills in recent California earthquakes.

Many, if not most, operating solid waste landfills in California are located in areas of significantly higher seismicity than the proposed Eagle Mountain facility. Over 30 California landfills were subjected to strong ground motions in the 1987 Whittier Narrows earthquake, 1989 Loma Prieta earthquake, and 1994 Northridge earthquake.

A number of these landfills were subjected to strong ground motions approaching or exceeding the conservatively-established design motions for the Eagle Mountain Landfill. The record of performance of these solid waste landfills in recent earthquakes is excellent. Observations from recent earthquakes provide no evidence of damage to solid waste landfills resulting in a release of waste to the environment due to seismic shaking. The primary impact of strong ground motions on the performance of landfills in recent earthquakes has been cracking of cover soils and disruption of landfill gas collection systems. In almost every case, repair of significant earthquake damage has been completed within 48 hours of the event by landfill staff using routine maintenance procedures with little to no disruption to landfill operations.

Observations of the performance of geosynthetic-lined areas at the Lopez Canyon and Bradley Avenue Landfills in the Northridge earthquake provide a clear demonstration that geosynthetic-lined landfills designed in accordance with Federal Subtitle D regulations (the same regulations used in the design of the Eagle Mountain Landfill) can withstand strong ground shaking without damage. Shear strength parameters for geomembrane-soil interfaces and for solid waste have been back-calculated from the observed performance of the Lopez Canyon and Chiquita Canyon Landfills in the Northridge event. The back-calculated strengths are larger than the design shear strengths used in the ROWD and ROWD-SV1 for seismic analysis of the Eagle Mountain Landfill.

From the information presented in the ROWD, ROWD-SV1, and this report, it is concluded that the Eagle Mountain Landfill will be very resistant to seismic upset and secure for any earthquake that can reasonably be anticipated at the project site. The factors contributing to this conclusion are:

- the location of the landfill site beyond (to the east) the region of historical high seismicity in southern California;
- the absence of known active faulting at, or in the vicinity of, the project site;

- the conservative design approach taken for the Eagle Mountain Landfill wherein the facility has been designed to satisfy both the prescriptive approach of the Subtitle D regulations and the alternative site-specific approach of California Chapter 15 regulations;

- the selection of conservative ground motion characteristics to associate with the design seismic events and conservative landfill and liner system material properties for use in seismic performance analyses;

- observations during recent earthquakes that solid waste landfills designed to similar seismic standards as the Eagle Mountain Landfill can withstand strong ground shaking; and

- observations of the good performance of geosynthetic-lined landfill areas subjected during the 1994 Northridge earthquake to strong ground motions of similar intensity to the design ground motions for the Eagle Mountain Landfill.

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1. INTRODUCTION

1.1 Terms of Reference

At the request of the Mine Reclamation Corporation (MRC), GeoSyntec Consultants (GeoSyntec) has reviewed and summarized observations of landfill performance in recent earthquakes and assessed the implication of these observations on the design of the proposed Eagle Mountain Landfill and Recycling Center (Eagle Mountain Landfill) in northeastern Riverside County, California. This work was performed in accordance with the scope of work proposed by GeoSyntec in a 20 July 1995 memorandum to Mr. Gary W. Johnson of MRC. The work was verbally authorized by Mr. Johnson on 21 July 1995.

This report was prepared by Dr. Neven Matasović and Dr. Edward Kavazanjian, Jr., P.E., G.E., both of GeoSyntec. The report was reviewed by Dr. Rudolph Bonaparte, P.E., and Mr. Paul Guptill, C.E.G., both of GeoSyntec, in accordance with the peer review policy of the firm.

1.2 Purpose and Scope of this Report

The purpose of this report is to assess the implications of observations of the performance of landfills in recent earthquakes on the seismic design of the Eagle Mountain Landfill. Current plans call for the landfill to be developed in five phases. The design of the first four phases of the landfill is presented in the Report of Waste Discharge (ROWD) [GeoSyntec, 1992] and in the first supplemental volume to the ROWD (i.e., ROWD-SV1 [GeoSyntec, 1993]). A ROWD for the fifth phase will be prepared at a later date. Detailed information on seismicity and seismic setting of the general landfill area presented in the ROWD and ROWD-SV1 is applicable to all five phases of landfill development. This information on seismicity and seismic setting is summarized in GeoSyntec [1996].

Observations of solid waste landfill performance in three recent earthquakes are summarized herein based upon information available in the technical literature. The implications of these observations with respect to the methods of analyses, design parameters, and results of analyses performed for seismic design of the Eagle Mountain Landfill are then presented. Particular attention is paid to the Northridge earthquake of 17 January 1994, an earthquake that subjected a large part of the greater Los Angeles area to high levels of ground acceleration. Observations from this earthquake provide direct evidence of the seismic performance of landfills designed in accordance with the provisions of Subtitle D of the Resource Conservation and Recovery Act (Subtitle D), as codified in Title 40, Section 258 of the Code of Federal Regulations.

1.3 Organization of this Report

The remainder of this report is organized as follows:

- *Section 2* - Background information on the design features of the Eagle Mountain Landfill and seismic design criteria and seismic design analyses for the landfill is discussed in this section.

- *Section 3* - A review of observations of the performance of solid waste landfills in recent earthquakes is presented in this section.

- *Section 4* - Implications of the observed seismic performance of solid waste landfills in recent earthquakes on the seismic design of the Eagle Mountain Landfill are discussed in this section. The adequacy of the seismic design analyses employed in the design of the Eagle Mountain facility is also addressed in Section 4, as is the validity of assumptions regarding the material properties used in these analyses and the reasonableness of the results of the analyses in light of observed landfill performance.

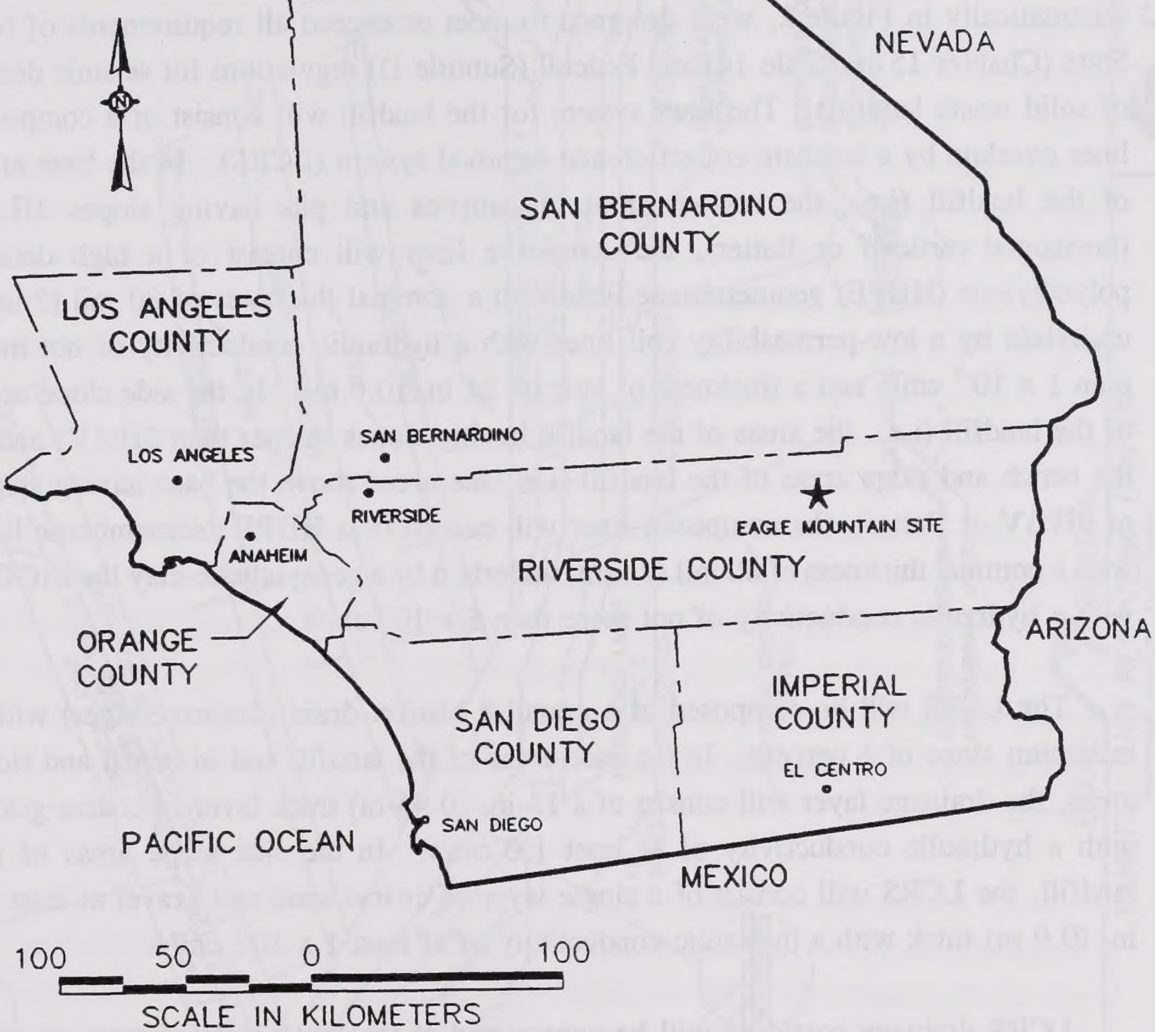
- *Section 5* - A summary and conclusions, along with a discussion of the limitations of the assessment of the performance of landfills in recent earthquakes described herein, are presented in this section of the report.

2. FACILITY DESIGN

2.1 Introduction

The Eagle Mountain Landfill will occupy approximately 2,154 acres (871 ha) of the site of a former open pit iron mine and ore processing facility. The project site, shown in Figure 1, is located about 160 miles (270 km) east of Los Angeles, in northeastern Riverside County, California. The landfill will be a canyon fill type of facility with waste slopes that measure over 1150 ft (350 m) from toe to crest and waste depths of over 660 ft (200 m) at some locations. MRC intends to develop, own, and operate the Eagle Mountain Landfill and Recycling Center as a California Class III nonhazardous solid waste disposal facility. Nonhazardous solid waste will be transported to the landfill, primarily by rail from transfer stations located in southern California and in lesser quantities by truck from local sources. Project plans currently identify five phases of landfill development. At the ultimate design capacity of 20,000 tons (18,000 tonnes) of solid waste per day, the total available airspace for the first four phases of landfill development of 670 million cubic yards (510 million cubic meters) will be filled up in 78 years.

The balance of this section of the report presents a brief description of the features of the waste containment systems proposed for the landfill, the seismic design criteria for the facility, and the seismic performance analyses performed to evaluate the ability of the landfill containment systems to resist damage resulting from seismically-induced ground motions. Detailed information on the design of the Eagle Mountain Landfill, including information on the configuration of the waste containment systems, the seismic setting of the site, and the seismic design analyses, are presented in detail in the ROWD and ROWD-SV1 [GeoSyntec, 1992, 1993] and in GeoSyntec [1996].



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SITE LOCATION MAP

FIGURE NO.	1
PROJECT NO.	GE3586-18
DATE:	MAY-13-96

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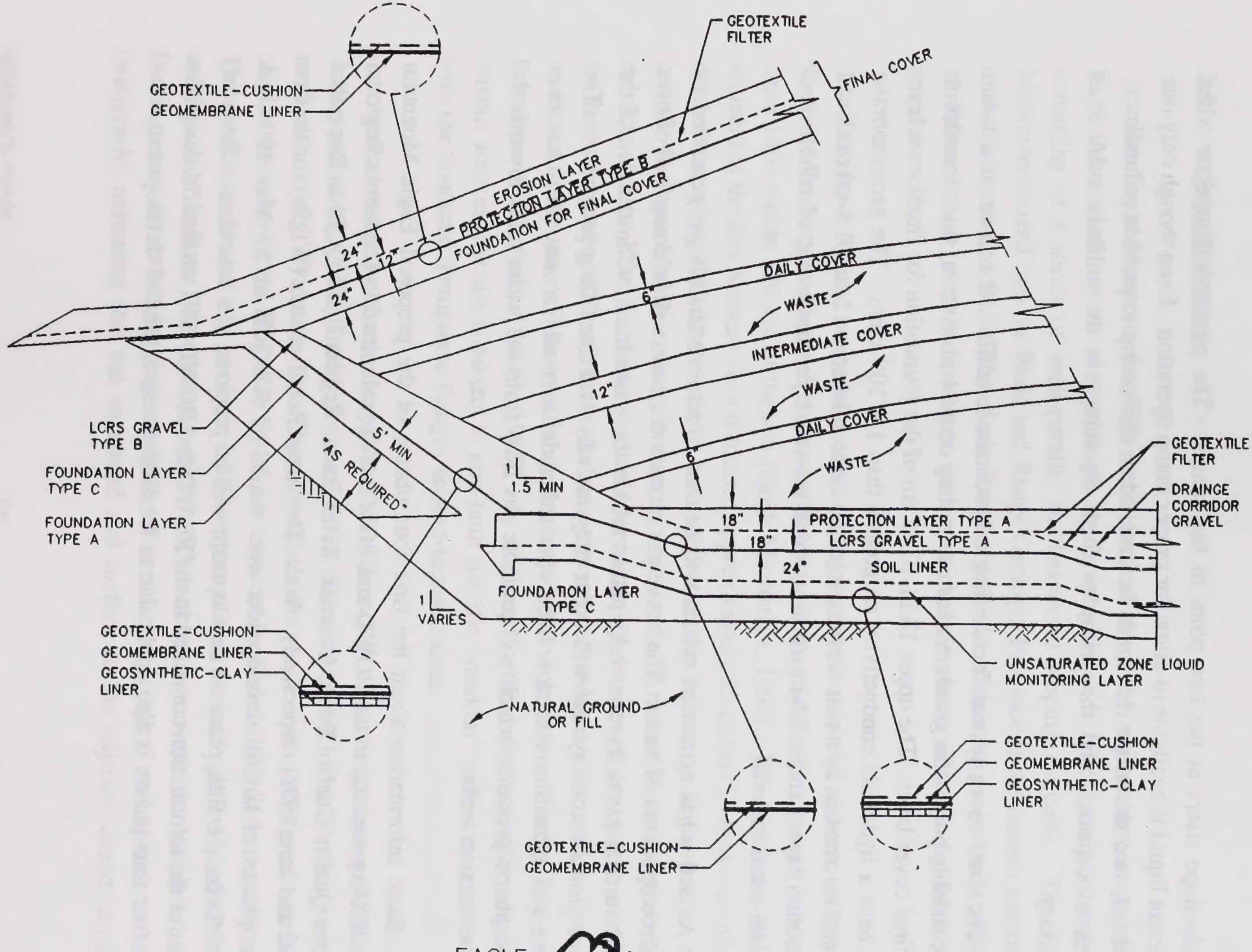
2.2 Facility Configuration

The waste containment systems for the Eagle Mountain Landfill, shown schematically in Figure 2, were designed to meet or exceed all requirements of both State (Chapter 15 and Title 14) and Federal (Subtitle D) regulations for seismic design of solid waste landfills. The liner system for the landfill will consist of a composite liner overlain by a leachate collection and removal system (LCRS). In the base areas of the landfill (i.e., the bottom areas of canyons and pits having slopes 3H:1V (horizontal:vertical) or flatter), the composite liner will consist of a high density polyethylene (HDPE) geomembrane liner with a nominal thickness of 80 mil (2 mm) underlain by a low-permeability soil liner with a hydraulic conductivity of not more than 1×10^{-7} cm/s and a thickness of at least 24 in. (0.6 m). In the side slope areas of the landfill (i.e., the areas of the landfill having slopes steeper than 3H:1V) and in the bench and ridge areas of the landfill (i.e., the areas above the base having slopes of 3H:1V or flatter), the composite liner will consist of a HDPE geomembrane liner with a nominal thickness of 80 mil (2 mm) underlain by a geosynthetic-clay liner (GCL) with a hydraulic conductivity of not more than 5×10^{-9} cm/s.

The LCRS will be composed of a granular blanket drain (drainage layer) with a minimum slope of 4 percent. In the base areas of the landfill and in bench and ridge areas, the drainage layer will consist of a 18-in. (0.45-m) thick layer of coarse gravel with a hydraulic conductivity of at least 1.0 cm/s. In the side slope areas of the landfill, the LCRS will consist of a single layer of coarse sand and gravel at least 36 in. (0.9 m) thick with a hydraulic conductivity of at least 1×10^{-2} cm/s.

LCRS drainage corridors will be constructed at the low points of major graded canyon areas. The drainage corridors will be constructed using coarse gravel material with a hydraulic conductivity of at least 1.0 cm/s. Liquids in the LCRS drainage layer will flow to the drainage corridors which, in turn, will convey the liquids to LCRS sumps at the lowest points within the landfill footprint. Liquid that drains into the LCRS sumps will be removed by pumping using dedicated submersible pumps placed



NOT TO SCALE

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WASTE CONTAINMENT SYSTEMS FOR THE EAGLE MOUNTAIN LANDFILL

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FIGURE NO.	2
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DATE:	MAY-13-96

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in side-slope risers at the low point of the sumps. The pumps will operate when sufficient liquid is available to allow for proper pump operation. Even though only one is needed, two side slope risers will be installed in each sump to provide redundancy, additional capacity, and the ability to flush the sumps in the unlikely event it is necessary.

The final cover system for the Eagle Mountain Landfill will consist of a 1-mm thick flexible polyolefin geomembrane cap resting on a 24-in. (0.6-m) thick foundation for final cover layer. The upper 18 in. (0.45 m) of the foundation for final cover layer will have a hydraulic conductivity no greater than 1 x 10^{-5} cm/s. The geomembrane cap will be overlain by a non-woven geotextile cushion layer, a 12-in. (0.3-m) thick soil protection layer, and a 24-in. (0.6-m) thick erosion layer consisting of cobble- and boulder-sized material.

An active gas extraction system will be used to remove landfill gas generated by the decomposition of waste. The active gas extraction system will be comprised of over 1,000 vertical gas extraction wells placed within the waste mass. Construction of the active gas extraction system will occur progressively as waste filling progresses. The active gas extraction system will be operated under a small vacuum (i.e., less than atmospheric pressure) which will promote gas flow from the waste mass towards the gas extraction wells.

Basic information about the first four phases of the proposed Eagle Mountain Landfill is presented in the ROWD and ROWD-SV1, submitted to California Regional Water Quality Control Board-Colorado River Basin, Region 7 (RWQCB) in December 1992 and June 1993, respectively. Waste Discharge Requirements (WDRs) for the first four phases of landfill development were issued by RWQCB on 17 May 1994. A ROWD for the fifth phase of development will be prepared at a later date. However, most of the information contained in the ROWD and ROWD-SV1 on landfill design for the first four phases is also applicable to the fifth phase of landfill development.

2.3 Seismic Setting

The Eagle Mountain Landfill site is located along the northeastern edge of the Eagle Mountains, in an area of high topographic relief. The terrain is rugged, consisting of a series of semi-parallel southeastward sloping canyons. The Eagle Mountains extend into the Basin and Range Geologic Province at the eastern extremity of the Southern California Transverse Ranges. Bedrock within the project area consists of Paleozoic-age meta-sedimentary rocks which have been intruded by Mesozoic igneous rocks.

The site is located beyond the zone of major historic recorded seismic activity in southern California. Figure 3 shows earthquakes of magnitude 4 or greater recorded since 1800 within 320 km of the site [Earth Mechanics, 1992]. The Coachella Valley segment of the San Andreas fault is located approximately 33 miles (53 km) west of the site. Other significant known faults with respect to the seismicity of the project site include the Pinto Mountain fault, located approximately 28 miles (45 km) northwest of the site, and the Blue Cut fault, located approximately 4 miles (6 km) to the north of the site. A number of small faults that are generally considered to be ancient features lie closer to the site. These smaller faults include the Substation, Victory Pass, and Porcupine Wash faults [Schell, 1992]. In addition to these fault-specific potential seismic sources, the site is subject to non-fault specific "random" seismicity associated with the Southeast Transverse Ranges seismo-tectonic zone.

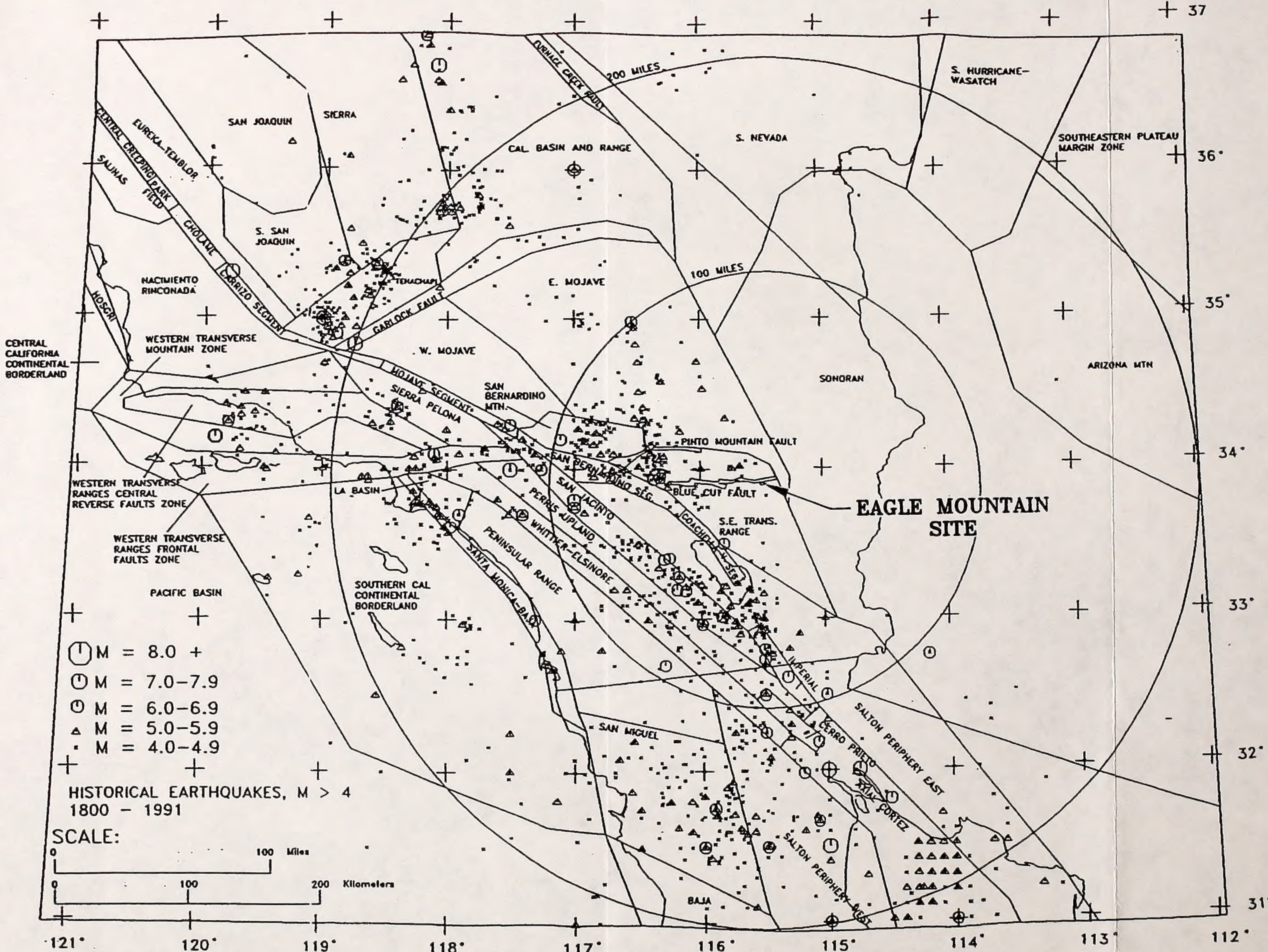
Several local faults were mapped at the site as part of investigations undertaken during permitting of the landfill [Proctor, 1992; Shlemon, 1992. These investigations produced strong evidence that these local faults have not undergone surface displacement during the Holocene Epoch, as required by Federal and State regulations. This evidence includes: (i) geologic field mapping within the mine pit and geochemical analyses that indicate that igneous dikes of Mesozoic age were not displaced by faulting; and (ii) trench logging, analyses of aerial photography, and studies of soil stratigraphy indicating that the varnished soil surface in the adjacent desert terrain

("desert pavement") has not been disturbed for at least 40,000 to 100,000 years. In fact, the results of the field reconnaissance and age-dating of igneous dikes crossing several of the fault traces at the site suggest that the last episode of active faulting occurred more than 100,000,000 years ago.

Figure 3 also shows the relationship of the Eagle Mountain Landfill site to major Quaternary fault zones in the state of California [Jennings, 1994]. Major Quaternary fault zones capable of generating strong ground shaking at the site include the San Andreas fault (divided into the Coachella Valley, Mojave, Carrizo Plain, and San Bernardino segments for the seismic hazard assessment of the Eagle Mountain site), the Imperial fault, the San Jacinto fault, the Pinto Mountain fault, and the Blue Cut fault. In addition to these well defined fault zones, the Southeast Transverse Ranges, Mojave, and Sonoran tectonic provinces are considered to be sources of random, non-fault specific earthquakes that could impact the site. While such "random" earthquakes are generally rare and relatively small in magnitude, their potential impact on the site was evaluated as part of the seismic hazard assessment performed for the Eagle Mountain facility described subsequently.

2.4 Seismic Design Criteria

The Eagle Mountain Landfill was designed to fully satisfy seismic design criteria contained in both Subtitle D and in Title 23, Chapter 15 (Chapter 15) and Title 14, Chapter 7 (Title 14) of the California Code of Regulations. The prescriptive seismic design criterion in Subtitle D requires that municipal solid waste landfills (California Class III landfills) be designed to resist the maximum expected horizontal acceleration in lithified earth (MHA) depicted on a seismic hazard map with a 90 percent or greater probability that the acceleration will not be exceeded in 250 years. The MHA represents a *probabilistic* seismic design standard and is typically evaluated from Map Sheet MF-2120 published by the United States Geological Survey (USGS) [Algermissen et al. 1990]. This map sheet is commonly referred to as the "Algermissen" map.



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SOUTHERN CALIFORNIA SEISMIC ZONES AND HISTORICAL SEISMICITY

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FIGURE NO.	3
PROJECT NO.	CE4030-02
DATE:	MAY-13-96

SOURCE: GeoSyntec (1992), REPORT OF WASTE DISCHARGE, EAGLE MOUNTAIN LANDFILL AND RECYCLING CENTER, APPENDIX D, MARTIN (1992)

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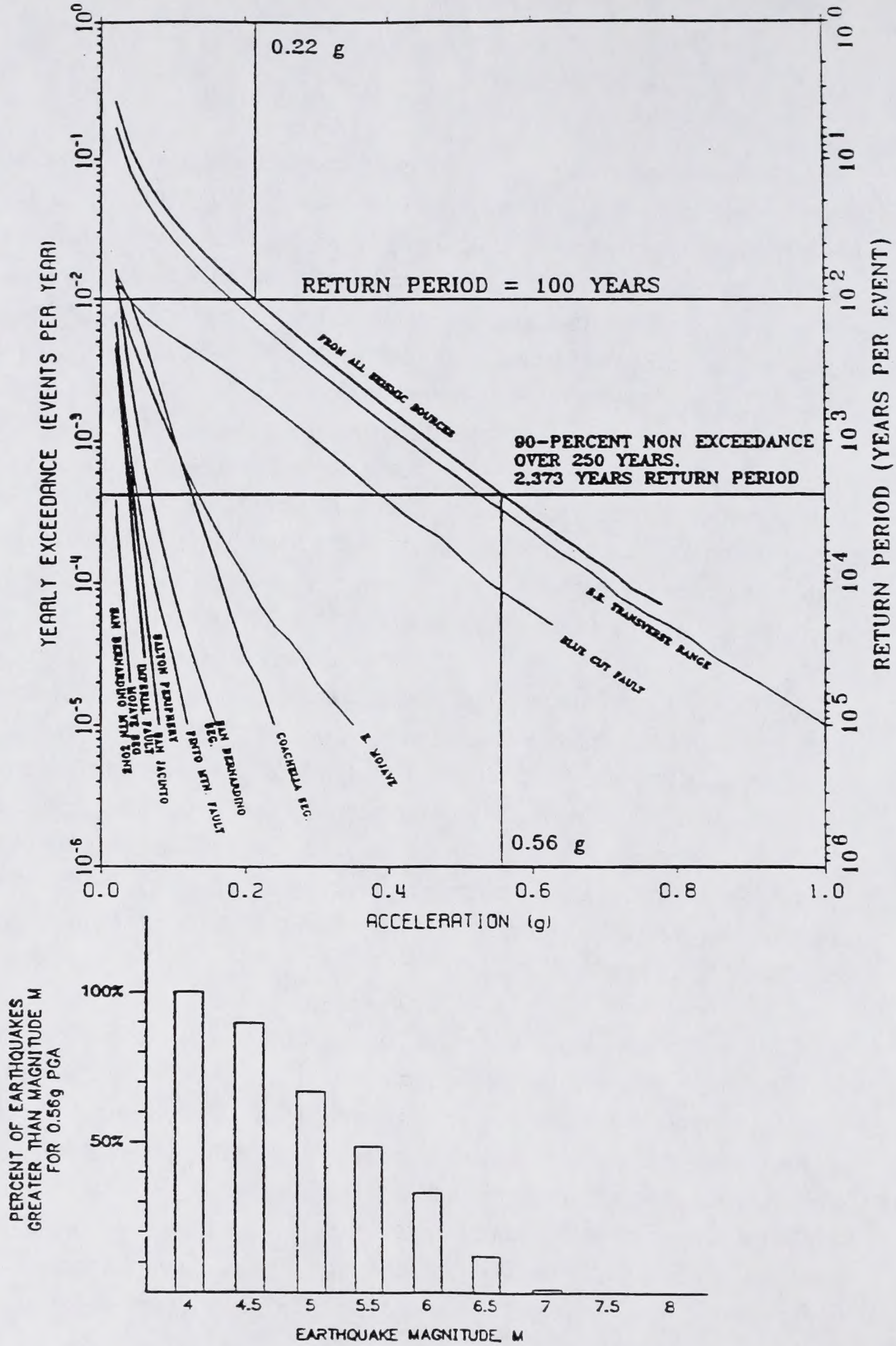
The most current version of the Algermissen map [Algermissen et al., 1990], identified by USGS as a draft map, indicates that the MHA for the Eagle Mountain Landfill site is slightly less than 0.60 g. To establish the applicability of the MHA from this draft map to the Eagle Mountain Landfill site and to establish the magnitude of the design earthquake associated with the MHA, a site-specific probabilistic hazard evaluation was conducted using up-to-date geological and seismological information [Martin, 1992]. Results of this site-specific probabilistic seismic hazard analysis, shown in Figure 4, yield a site-specific probabilistic MHA of 0.56 g. In the site-specific seismic hazard analysis, this MHA is attributed to either a "random," non-fault specific earthquake in the Southeast Transverse Ranges seismo-tectonic zone or an earthquake on the nearby potentially-active Blue Cut fault. The inferred magnitude (M) of this design earthquake is 6.0 to 6.5 and it is assumed to occur at a distance of approximately 5 miles (8 km) from the site.

In the site-specific probabilistic seismic hazard analysis, the random seismicity associated with the Southeast Transverse Ranges seismo-tectonic zone was distributed uniformly across the zone. As shown in Figure 3, the Eagle Mountain Landfill site is on the eastern edge of the Southeast Transverse Ranges zone, where historical seismic activity is significantly lower than in the rest of the zone. Therefore, the results of the site-specific seismic hazard assessment are considered to provide a conservative assessment of the shaking intensity associated with the prescriptive Subtitle D design earthquake ground motions.

California regulations for seismic design of Class III (municipal solid waste) landfills employ an alternative site-specific seismic risk analysis approach for evaluating the design earthquake ground motions. Chapter 15 and Title 14 of the California Code of Regulations require that California Class III landfills be designed to withstand without damage the Maximum Probable Earthquake (MPE), defined in accordance with California Department of Conservation Division of Mines and Geology (CDMG) standards. The CDMG defines the MPE as the maximum earthquake expected to impact the site in a 100 year period [CDMG, 1975], established on the basis of a site-



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PROBABILISTIC HAZARD ANALYSIS RESULTS FOR THE EAGLE MOUNTAIN LANDFILL

FIGURE NO.	4
PROJECT NO.	GE3586-18
DATE:	MAY-13-96

DWG: 3586F001 199605131709 AB

specific seismic hazard analysis. The term maximum is commonly interpreted to mean the most damaging earthquake, as opposed to the earthquake with the maximum expected horizontal acceleration. In this manner, the definition of the MPE accounts for the possibility that a far-field event of large magnitude but lower peak intensity may be more damaging than a near-field event of lesser magnitude but greater intensity. The MPE as defined by CDMG represents a *deterministic* seismic design standard.

In evaluating the MPE for the Eagle Mountain Landfill, both near-field and far-field events were considered. Based upon the findings of the Working Group on the Probabilities of Large Future Earthquakes in Southern California (WGPLFESC) [WGPLFESC, 1992], the far-field MPE was established in the ROWD-SV1 as a M 7.8 event at a distance of 33 miles (53 km) from the site resulting from the concurrent rupture of two adjacent segments of the San Andreas fault and generating a peak horizontal ground acceleration (PGA) of 0.14 g in lithified earth at the site. The near-field MPE was established as a M 6.0 to 6.5 earthquake generating a PGA of 0.22 g in lithified earth at the site.

CDMG standards also define a second, more severe design earthquake than the MPE, the Maximum Credible Earthquake (MCE). The MCE is defined by CDMG [1975] as the maximum earthquake capable of occurring under the presently known tectonic framework. Based upon the findings of the WGPLFESC [1992], the MCE was established in ROWD-SV1 as a M 8.0 event at a distance of 33 miles (53 km) from the site rupturing three consecutive sections of the San Andreas fault and generating a PGA of 0.16 g in lithified earth at the site. To provide a conservative basis for assessment of the performance of the landfill when subjected to the California regulatory design earthquake, this MCE PGA was used as the PGA for the far-field design event for the seismic performance analyses for the Eagle Mountain Landfill. It is noted that there is no regulatory requirement to use this higher value of PGA (i.e., 0.16 g instead of 0.14 g) to evaluate the potential impacts of a far-field MPE. This higher PGA was used only for purposes of conservatism.

It is noteworthy that the Federal prescriptive probabilistic seismic design standard and the alternative site-specific deterministic design standard employed by California are significantly more stringent than the design standard typically required for construction of commercial and residential structures. The Uniform Building Code [UBC, 1994] and the National Earthquake Hazard Reduction Program Recommended Provisions for the Development of Seismic Regulations for New Buildings [Building Seismic Safety Council, 1991] both suggest that commercial and residential structures be designed for ground motions with a 90 percent probability of not being exceeded in 50 years, compared to the 250-year time period specified in the Subtitle D regulations. The MPE design criteria for landfills specified in California regulations are typically used for seismic design of highway bridges by the California Department of Transportation (Caltrans), while the MCE standard to which the landfill was designed is used in California for design of schools, hospitals, fire stations, and other critical facilities. Despite the damage to older highway structures in recent California earthquakes, highway bridges designed to current standards withstood both the 1989 Loma Prieta (San Francisco) earthquake and the 1994 Northridge earthquake without significant damage [Housner et al., 1994].

2.5 Seismic Performance Analysis

Seismic performance analyses for the Eagle Mountain Landfill were conducted in accordance with the design procedures described in the *RCRA Subtitle D (258) Seismic Design Guidance for Municipal Solid Waste Landfill Facilities* [USEPA, 1995]. The seismic loads on the containment system elements were evaluated on the basis of one-dimensional wave propagation analyses performed using a suite of time histories selected from the catalog of available time histories to represent the design earthquakes established on the basis of the prescriptive Subtitle D and California standards. The wave propagation analyses were performed using the equivalent-linear computer program SHAKE [Schnabel et al., 1972]. SHAKE was used to calculate the response of representative columns of waste to the vertically propagating shear waves from the

design earthquakes. The horizontal acceleration-time history at the top of the waste column was used as the measure of the seismic load on the final cover system. The average acceleration time history of the waste column, proportional to the shear stress time history at the base of the column, was used as the measure of the seismic loading on the liner system.

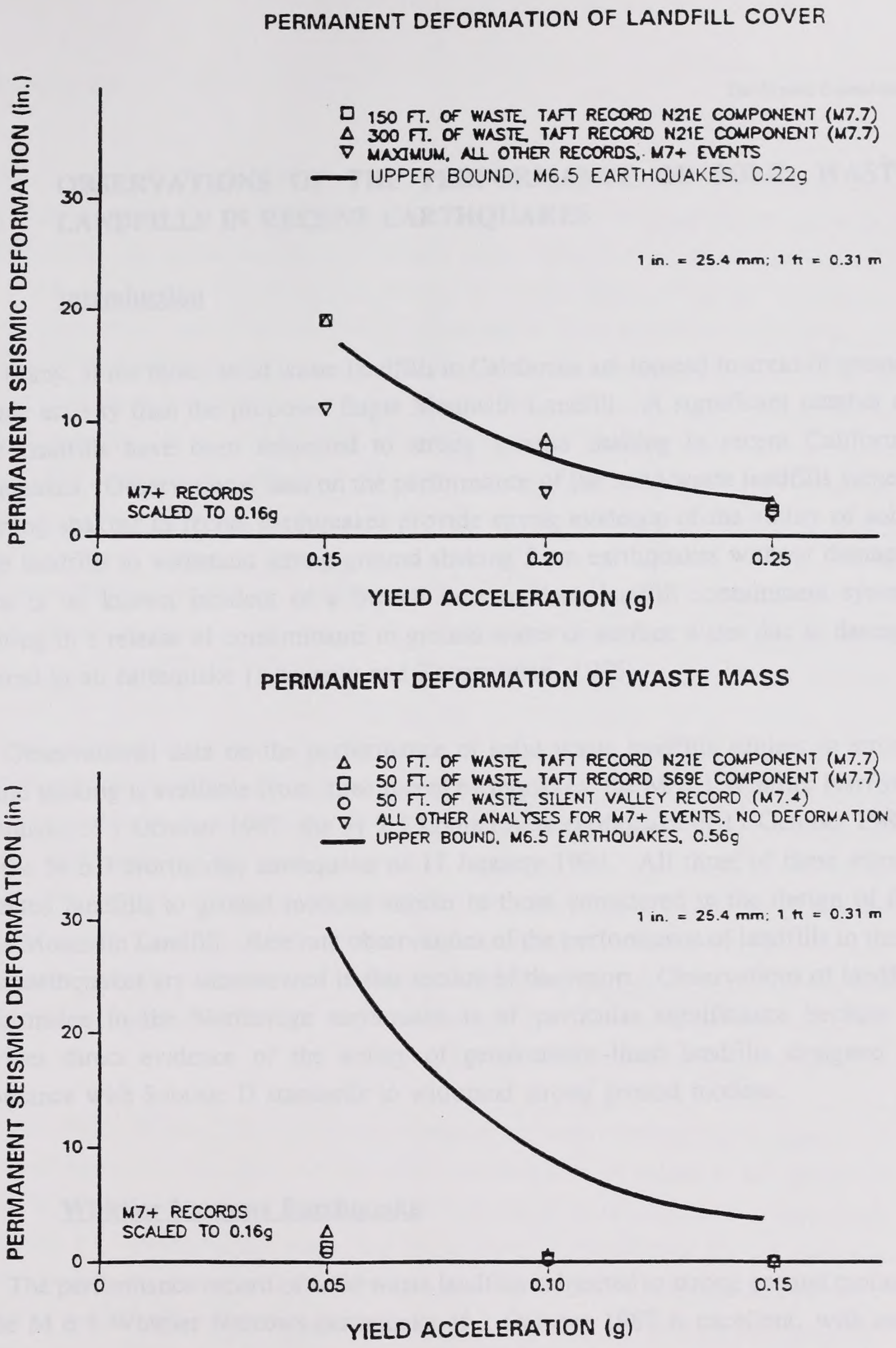
Pseudo-static limit equilibrium stability analyses were used to evaluate the ability of the containment system elements to withstand seismic loading. Analyses were conducted to evaluate the seismic coefficient resulting in a factor of safety of 1.0 for potential slip surfaces passing along interfaces in the liner and cover system. This seismic coefficient, termed the *yield acceleration*, was used as the measure of the seismic resistance of the containment system elements.

The seismic performance of the waste containment systems was evaluated by comparing the yield acceleration to the acceleration-time history for both the liner and final cover systems. This comparison was performed in a quantitative manner using a "Newmark" analysis [Newmark, 1965]. In a Newmark analysis for a landfill, the excursions of the acceleration-time history above the yield acceleration are double-integrated to provide estimates of the permanent seismic deformations that accumulate along material interfaces in the liner system and final cover system. Calculated permanent seismic deformations of less than 6 to 12 in. (150 to 300 mm) are generally considered to represent acceptable seismic performance of landfills [Seed and Bonaparte, 1992; Anderson and Kavazanjian, 1995].

The seismic performance of the landfill liner system was evaluated for both the prescriptive Subtitle D design earthquake and the far-field MPE. Seismic performance analyses of the liner system for the near-field MPE were not necessary, as this event is of the same magnitude, but lesser intensity than the prescriptive Subtitle D event. The seismic performance of the landfill final cover system was evaluated only for the near- and far-field MPEs. Analysis of the final cover system for the prescriptive Subtitle D design event was not necessary, as USEPA has interpreted the Subtitle D

seismic design standard as not being directly applicable to final cover systems, noting that earthquake-induced impacts to final cover systems are observable (through post-earthquake inspections which are mandatory in California) and repairable.

Figure 5 shows results of the permanent seismic deformation analyses for the Eagle Mountain Landfill expressed as a function of the yield acceleration for both the liner and final cover systems. These curves, taken form the ROWD and ROWD-SV1, indicate that the prescriptive Subtitle D earthquake results in the significantly larger calculated permanent seismic deformation for the landfill liner system than the far-field MPE. For the landfill final cover system, the near-field and far-field California MPE design events produce essentially the same amount of calculated permanent seismic deformation.



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CALCULATED PERMANENT SEISMIC DEFORMATIONS OF THE EAGLE MOUNTAIN LANDFILL

FIGURE NO.	5
PROJECT NO.	GE3586-18
DATE:	MAY-13-96

DWG: 3586F001 199605131709 AB

3. OBSERVATIONS OF THE PERFORMANCE OF SOLID WASTE LANDFILLS IN RECENT EARTHQUAKES

3.1 Introduction

Many, if not most, solid waste landfills in California are located in areas of greater seismic activity than the proposed Eagle Mountain Landfill. A significant number of these landfills have been subjected to strong ground shaking in recent California earthquakes. Observational data on the performance of the solid waste landfills subject to strong shaking in recent earthquakes provide strong evidence of the ability of solid waste landfills to withstand strong ground shaking from earthquakes without damage. There is no known incident of a breach in a modern landfill containment system resulting in a release of contaminants to ground water or surface water due to damage suffered in an earthquake [Anderson and Kavazanjian, 1995].

Observational data on the performance of solid waste landfills subject to strong ground shaking is available from three recent earthquakes: the M 6.1 Whittier Narrows earthquake of 1 October 1987, the M 7.1 Loma Prieta earthquake of 17 October 1989, and the M 6.7 Northridge earthquake of 17 January 1994. All three of these events subjected landfills to ground motions similar to those considered in the design of the Eagle Mountain Landfill. Relevant observations of the performance of landfills in these three earthquakes are summarized in this section of the report. Observations of landfill performance in the Northridge earthquake is of particular significance because it provides direct evidence of the ability of geosynthetic-lined landfills designed in accordance with Subtitle D standards to withstand strong ground motions.

3.2 Whittier Narrows Earthquake

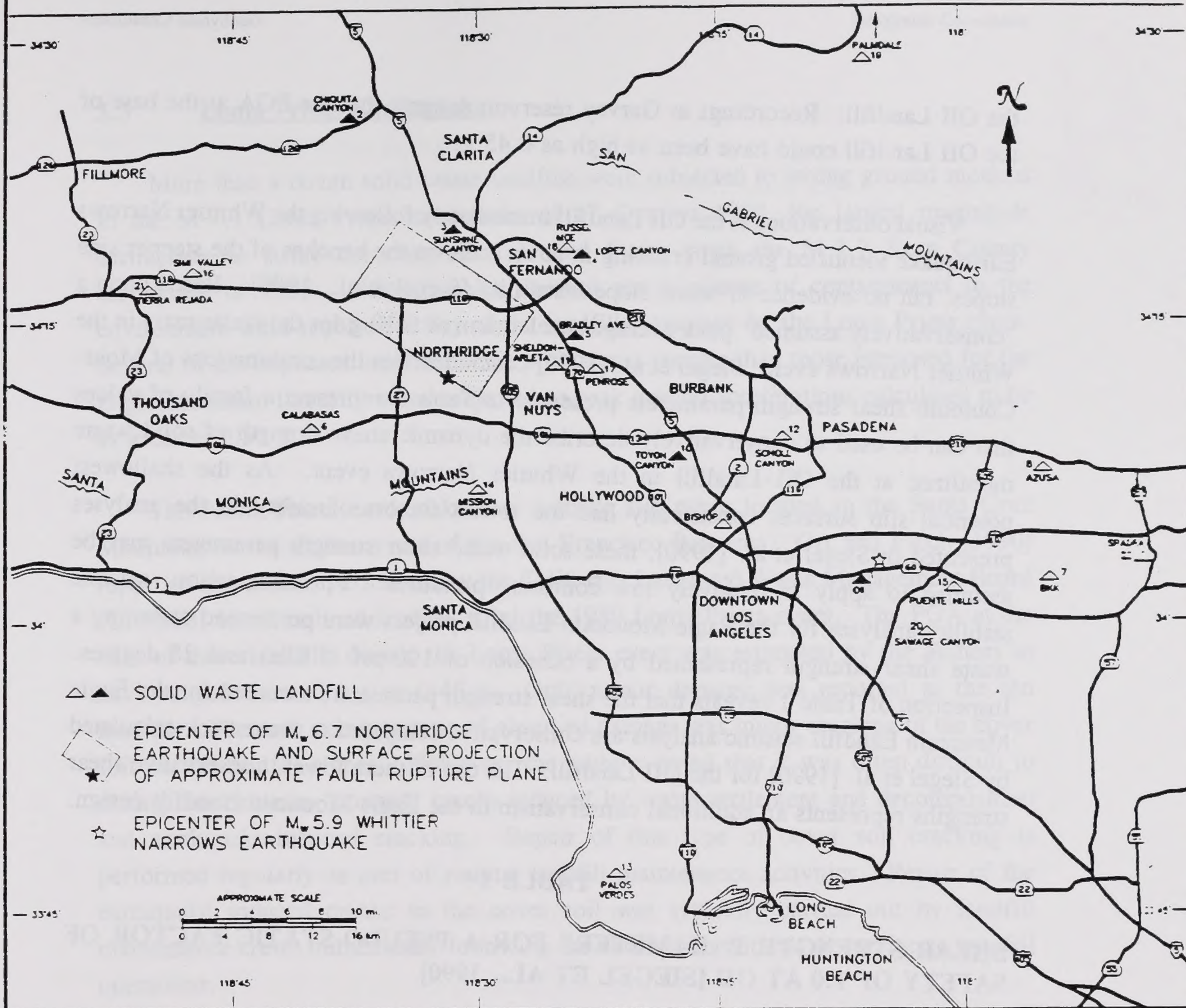
The performance record of solid waste landfills subjected to strong ground motions in the M 6.1 Whittier Narrows earthquake of 1 October 1987 is excellent, with only

very limited, minor cracking in cover soils on the side slopes at one landfill reported following the earthquake. Furthermore, the one landfill at which this minor damage was reported is atypical of solid waste landfills in general and of the Eagle Mountain Landfill in particular. The slopes on which the cracking occurred are some of the steepest slopes known to exist at any solid waste landfill in the United States and are more than twice as steep as the waste slopes proposed for the Eagle Mountain facility. In fact, solid waste shear strengths back calculated from the performance of the waste slopes at this landfill in the Whittier Narrows event [Siegel et al., 1990] indicate that the waste shear strengths used in the evaluation of the static and seismic stability of the Eagle Mountain Landfill are conservative.

The epicenter of the Whittier Narrows earthquake of 1 October 1987 was located at the eastern edge of the Los Angeles basin (Figure 6), near the border of the basin with the San Gabriel Valley to the east.

The main shock occurred as a reverse (thrust) motion on a buried fault at an approximate depth of 6.2 to 8.7 miles (10 to 14 km) with no surface expression of fault displacement. Performance information is available for five unlined landfills located in the area subject to strong shaking. Two of the landfills, the Operating Industries, Inc. (OII) Landfill and the Puente Hills Landfill, were within the zone of very strong ground motion for the event. Three other landfills, Savage Canyon, BKK, and Azusa, were subject to ground motions of moderate to strong intensity. None of these landfills are reported to have suffered any damage of significance, and only the OII Landfill is reported to have suffered minor damage.

Siegel et al. [1990] report on observations at the OII Landfill made immediately following the Whittier Narrows event. Slopes at the OII Landfill range from 3H:1V (horizontal to vertical) to as steep as 1.3H:1V for heights up to 246 ft (75 m). The epicenter for the earthquake is reported to have been approximately 2.5 miles (4 km) from the OII Landfill. The closest point to the landfill at which ground motions were recorded was the Garvey reservoir, also located approximately 2.5 miles (4 km) from



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MINE RECLAMATION CORPORATION

GEOSYNTEC CONSULTANTS
HUNTINGTON BEACH, CALIFORNIA

MAJOR SOLID WASTE LANDFILLS IN THE GREATER LOS ANGELES AREA

FIGURE NO.	6
PROJECT NO.	GE3586-18
DATE:	MAY-13-96

DWG: 3586F001 199605131709 AB

the OII Landfill. Recordings at Garvey reservoir suggest that the PGA at the base of the OII Landfill could have been as high as 0.45 g.

Visual observations at the OII Landfill immediately following the Whittier Narrows Earthquake identified ground cracking in cover soils on the benches of the steeper side slopes, but no evidence of waste slope instability [Siegel et al., 1990]. Based upon a "conservatively assumed" peak average acceleration of 0.10 g for the waste mass in the Whittier Narrows event, Siegel et al. [1990] concluded that the combinations of Mohr-Coulomb shear strength parameters presented in Table 1 represent a family of values that can be used to conservatively describe the dynamic shear strength of solid waste mobilized at the OII Landfill in the Whittier Narrows event. As the shallowest potential slip surfaces consistently had the lowest factors of safety in the analyses presented in Siegel et al. [1990], these solid waste shear strength parameters may be assumed to apply to relatively low confining pressures. For comparison, seismic stability analyses for the Eagle Mountain Landfill project were performed assuming a waste shear strength represented by a cohesion of 100 psf (5 kPa) and 28 degrees. Inspection of Table 1 reveals that the shear strength parameters assumed for the Eagle Mountain Landfill seismic analysis are conservative compared to those back-calculated by Siegel et al. [1990] for the OII Landfill. The use of these lower, conservative shear strengths represents an additional conservatism in the Eagle Mountain Landfill design.

TABLE 1

SHEAR STRENGTH PARAMETERS FOR A PSEUDO-STATIC FACTOR OF SAFETY OF 1.0 AT OII [SIEGEL ET AL., 1990]

FRICTION ANGLE (degrees)	COHESION INTERCEPT (psf (kPa))
38 degrees	0 (0)
30 degrees	200 (10)
20 degrees	400 (40)

3.3 Loma Prieta Earthquake

More than a dozen solid waste landfills were subjected to strong ground motions in the M 7.1 Loma Prieta earthquake of 17 October 1989, the largest magnitude earthquake to strike the continental United States since the M 7.7 Kern County earthquake of 1952. Neither major damage nor a release of contaminants to the environment were reported at any of the landfills impacted by the Loma Prieta event. Several of the impacted landfills, some with slopes steeper than those proposed for the Eagle Mountain Landfill, were subjected to peak ground accelerations calculated to be as great as 0.50 g.

The Loma Prieta earthquake was a strike slip event located in the Santa Cruz Mountains at the southern end of the San Francisco Bay area. Orr and Finch [1990] report on inspections performed by the California Integrated Waste Management Board (CIWMB) of ten unlined landfills after the 1989 Loma Prieta event. The PGA at the base of these landfills during the Loma Prieta event was estimated by the authors to have ranged from 0.1 g to 0.45 g. Only minor damage was reported at the ten landfills. The most common type of observed damage was minor cracking of the cover soil on the landfill slopes. However, the authors noted that it was often difficult to distinguish between "normal" cracks induced by waste settlement and decomposition and earthquake-induced cracking. Repair of this type of cover soil cracking is performed regularly as part of routine landfill maintenance activities. Repair of the earthquake induced cracks in the cover soil was typically carried out by landfill maintenance crews immediately following the earthquake without disruption to landfill operations.

Orr and Finch note that the landfill gas recovery systems were temporarily affected by power loss and above-ground pipe breakage at a number of the landfills impacted by the Loma Prieta earthquake. However, all landfill gas recovery systems were repaired and back in operation within 24 hours of the earthquake and no post-earthquake changes in quantities of leachate and landfill gas recovery were reported.

In their conclusions, these authors report that a total of 13 solid waste landfills, including the ten inspected by CIWMB, subjected to strong ground motions in the Loma Prieta event experienced only minor damage evidenced by cracking in surficial cover soils and temporary disruption to gas collection systems.

The performance of landfills during the Loma Prieta earthquake was also investigated by Johnson et al. [1991]. These investigators report on the behavior of ten unlined landfills, including seven of those reported on by Orr and Finch [1990]. PGAs at the ten landfills investigated by Johnson et al. were estimated to have varied from 0.04 g to 0.50 g. The authors report that the slopes of landfills performed well, with minor cracking of cover soils the only observed damage. This included 2H:1V (horizontal:vertical) slopes up to 150 ft (45 m) high at the Santa Cruz Landfill, where the estimated free-field PGA was 0.45 g, 3H:1V slopes up to 150 ft (45 m) high at the Ben Lomond Landfill, where the estimated free-field PGA was 0.50 g, and 2H:1V slopes up to 250 ft (75 m) high at the Kirby Road Landfill where the estimated free-field PGA was 0.50 g. The authors note that cracking of cover soils on the slopes at these landfills was generally limited to contact zones between areas of dissimilar materials and areas of changes in geometry. These are the same areas where cracks tend to form in the cover soil due to waste settlement under normal operating conditions.

Buranek and Prasad [1991] report on the performance of six unlined landfills in the Loma Prieta earthquake, including two landfills reported on by Johnson et al. [1991] and Orr and Finch [1990]. PGAs at the base of the six landfills reported on by Buranek and Prasad were estimated to range from 0.15 g to 0.45 g. Minor cover soil cracking was observed at four of these sites. Transition zones between different materials (e.g., waste fill and natural ground) and between areas of different waste face geometry were cited for most crack locations. Typical crack displacements were on the order of 1 to 3 in. (25 to 75 mm). At one site, minor downslope cover soil movement was observed. At another site, apparent horizontal displacement was observed in rigid landfill gas control piping.

3.4 Northridge Earthquake

The M 6.7 Northridge earthquake of 17 January 1994 provides direct evidence of the ability of geosynthetic-lined landfills designed in accordance with Subtitle D regulations to withstand strong shaking from a major earthquake without damage. Three landfills located in the epicentral area of this event had geosynthetic liner systems designed in compliance with Subtitle D regulatory requirements. Two of these landfills withstood the earthquake without damage to the liner system or disruption to landfill operations. The third landfill suffered some damage to the containment system, but the damage was above the waste and did not result in a release of contaminants to the environment. Furthermore, mobilized shear strengths back calculated for solid waste and for geosynthetic interfaces from the observed performance of lined and unlined landfills in the Northridge event [Augello et al., 1995] indicate that the shear strength parameters used in design of the Eagle Mountain Landfill provide a conservative basis for seismic design of the facility. This is the same conclusion reached earlier (in Section 3.2 of this report) using observations of the performance of the OII Landfill during the Whittier Narrows event.

The main shock of the Northridge earthquake occurred as a reverse (thrust) motion on a southward-dipping plane at a depth of approximately 9.3 miles (15 km) at the northern end of the San Fernando Valley in the Los Angeles metropolitan area. Numerous active, inactive, and closed solid waste landfills are located within 62 miles (100 km) of the earthquake epicenter. Stewart et al. [1994] provide preliminary data on the performance of several major landfills in the epicentral region. Matasović et al. [1995] summarize information on the performance of 22 landfills that experienced shaking estimated to be in excess of 0.06 g. The locations of these landfills are shown

TABLE 2

DAMAGE CATEGORIES FOR SOLID WASTE LANDFILLS [MATASOVIĆ ET AL., 1995]

DAMAGE CATEGORY	DESCRIPTION
V. Major Damage	General instability with significant deformations. Integrity of the waste containment system compromised.
IV. Significant Damage	Waste containment system impaired, but no release of contaminants. Damage cannot be repaired within 48 hours. Specialty contractor needed to repair the damage.
III. Moderate Damage	Damage repaired by landfill staff within 48 hours. No compromise of the waste containment system integrity.
II. Minor Damage	Damage repaired without interruption to regular landfill operations.
I. Little or No Damage	No damage or slight damage but no immediate repair needed.

Table 3. Seismic Response of Solid waste Landfills During the 17 January 1994 Northridge Earthquake [Matasović et al., 1995]

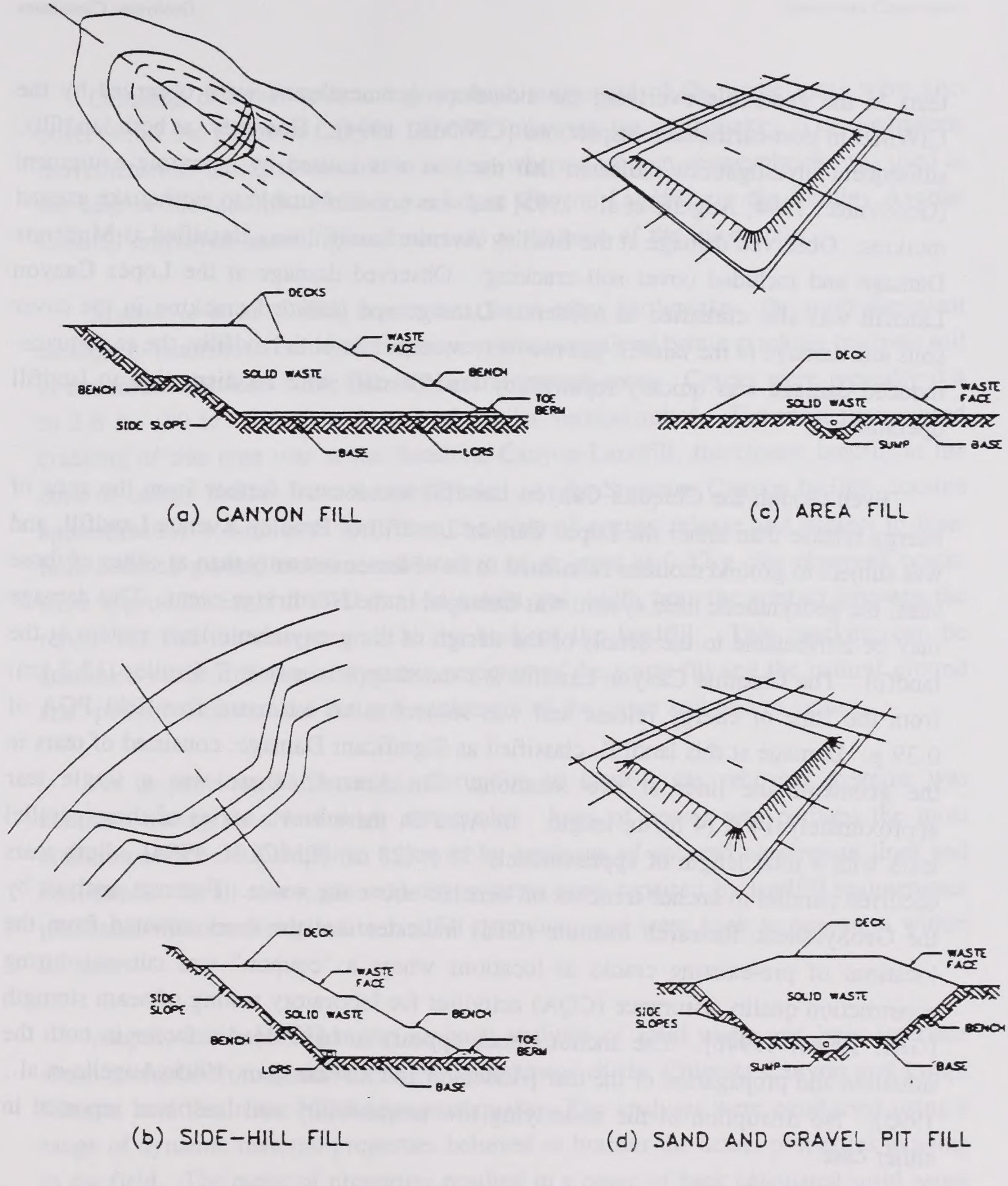
SOLID WASTE LANDFILL	EPICENTRAL DISTANCE miles (km)	DISTANCE FROM ZONE OF ENERGY RELEASE miles (km)	ESTIM. PEAK HORIZONTAL ACCELERATION g	DAMAGE CATEGORY (I-V)	DAMAGED ELEMENT
1. OII	27.9 (44.9)	26.7 (43)	0.25 - 0.26 g	Minor Damage (II)	Cover Soil
2. Chiquita Canyon	16.0 (25.8)	7.6 (12.2)	0.39 g	Significant Damage (IV)	Cover Soil; 2 Geomembrane Liner Tears
3. Sunshine Canyon	8.5 (13.7)	4.4 (7)	0.52 g	Moderate Damage (III)	Cover Soil
4. Lopez Canyon	10.5 (16.9)	5.2 (8.4)	0.44 g	Moderate Damage (III)	Cover Soil; Gas System
5. Bradley Avenue	9.5 (15.3)	6.7 (10.8)	0.45 g	Significant Damage (IV)	Cover Soil
6. Calabasas	9.5 (15.3)	14.4 (23.1)	0.25 g	Moderate Damage (III)	Gas System; Cover Soil
7. BKK	38.5 (62.0)	35.5 (57.2)	0.14 g	No Damage (I)	None
8. Azusa	37.5 (60.4)	32.1 (51.7)	0.10 g	No Damage (I)	None
9. Bishop Canyon	17.8 (28.7)	19.1 (30.7)	0.30 g	Little Damage (I)	Cover Soil
10. Toyon Canyon	14.5 (23.3)	13.8 (22.2)	0.25 g	Minor Damage (II)	Cover Soil; Gas Collection Header
11. Sheldon-Arleta	7.9 (12.7)	6.7 (10.7)	0.51 g	Minor Damage (II)	Cover Soil; Gas Collection Headers
12. Scholl Canyon	21.0 (33.8)	17.6 (28.4)	0.26 g	Moderate Damage (III)	Cover Soil
13. Palos Verdes	32.0 (51.5)	31.6 (50.8)	0.12 g	No Damage (I)	None
14. Mission Canyon	8.7 (14.0)	11.4 (18.4)	0.40 g	No Damage (I)	None
15. Puente Hills	33.5 (53.9)	30.9 (49.7)	0.11 g	No Damage (I)	None
16. Simi Valley	17.0 (27.4)	13.9 (22.3)	0.28 g	Minor Damage (II)	Cover Soil; Gas System; Leachate Pump
17. Penrose	9.0 (14.5)	7.6 (12.2)	0.35 g		
18. Russel Moe	10.0 (16.1)	4.9 (7.8)	0.44 g	Moderate Damage (III)	Cover Soil
19. Palmdale	35.0 (56.4)	25.5 (41.1)	0.07 g	Minor Damage (II)	Cover Soil
20. Savage Canyon	35.0 (56.4)	32.8 (52.8)	0.16 g	No Damage (I)	None
21. Terra Rejada	17.5 (28.2)	13.9 (22.4)	0.27 g	Minor Damage (II)	Cover Soil
22. Spadra	44.0 (70.8)	34.2 (55.1)	0.06 g	No Damage (I)	None

on Figure 6. At 16 of these sites the free-field PGA at the base of the landfill was estimated to be in excess of 0.24 g. At six sites the free-field PGA at the base of the fill was estimated to be in excess of 0.38 g.

Figure 7 shows the generic configurations of the 22 landfills encompassed by the Matasović et al. [1995] study. Slope heights at these landfills were up to 295 ft (90 m) at inclinations as steep as 1.3H:1V. Damage at the 22 landfills was classified according to the five damage categories presented in Table 2, varying from "Little or No Damage" (Damage Category I) to "Major Damage" (Damage Category V). Table 3 summarizes damage observations at the 22 landfills. Major Damage was defined as a breach of the waste containment system and release of contaminants to the environment, while Significant Damage (Damage Category IV) was defined as impairment of the waste containment system but no release of contaminants. Of the 22 landfills surveyed, none suffered Major Damage and only two suffered Significant Damage. Note that the Significant Damage classification in Table 3 does not imply a release of contaminants to the environment or irreparable damage to the waste containment system. It only connotes that damage could not be repaired by landfill staff within 48 hours.

Four of the landfills surveyed suffered Moderate Damage, defined as damage repaired by landfill staff within 48 hours, and the remaining 17 suffered Minor Damage or No Damage, according to the survey. These data, taken together, indicate very good performance of landfill facilities during the M 6.7 Northridge event.

Three of the landfills subject to the strongest shaking in the Northridge event had geosynthetic liner systems meeting current Subtitle D liner system design requirements. Two of these landfills, the Lopez Canyon Landfill and the Bradley Avenue Landfill, withstood the earthquake without any indications of damage to their geosynthetic liner systems. The Lopez Canyon Landfill is located within 5.2 miles (8.4 km) of the zone of energy release and was subject to an estimated free-field PGA of 0.44 g. The Bradley Avenue Landfill is located within 6.7 miles (10.8 km) of the zone of energy release and was subject to an estimated free-field PGA of 0.45 g. At both sites, local



[Matasović et al., 1995]

EAGLE MOUNTAIN
LANDFILL AND RECYCLING CENTER
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MINE RECLAMATION CORPORATION

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GENERIC LANDFILL TYPES

FIGURE NO.	7
PROJECT NO.	GE3586-18
DATE:	MAY-13-96

DWG: 3586F001 199605131709 AB

tears in the geotextile overlying the side-slope geomembrane were observed by the CIWMB in post-earthquake inspections [CIWMB, 1994]. However, at both landfills, subsequent investigations indicated that the tear was caused by operating equipment [GeoSyntec, 1994; Augello et al., 1995] and was not attributable to earthquake ground motions. Observed damage at the Bradley Avenue Landfill was classified as Moderate Damage and included cover soil cracking. Observed damage at the Lopez Canyon Landfill was also classified as Moderate Damage and included cracking in the cover soils and damage to the landfill gas recovery system. At both landfills, the earthquake-induced damage was quickly repaired by landfill staff with no disruption to landfill operations.

Even though the Chiquita Canyon Landfill was located further from the zone of energy release than either the Lopez Canyon Landfill or Bradley Avenue Landfill, and was subject to ground motions calculated to be of lesser intensity than at either of those sites, the geosynthetic liner system was damaged in the Northridge event. This damage may be attributable to the details of the design of the geosynthetic liner system at the landfill. The Chiquita Canyon Landfill is located approximately 7.6 miles (12.2 km) from the zone of energy release and was subject to an estimated free-field PGA of 0.39 g. Damage at this landfill, classified as Significant Damage, consisted of tears in the geomembrane liner at two locations. In Area C, there was a single tear approximately 14 ft (4 m) in length. In Area D, there was a series of three parallel tears with a total length of approximately 75 ft (23 m) [EMCON, 1994]. Both tears occurred parallel to anchor trenches on benches above the waste. Forensic analysis by the GeoSynthetic Research Institute (GRI) indicates that the tears initiated from the locations of pre-existing cracks at locations where a "coupon" was cut out during construction quality assurance (CQA) activities for laboratory testing of seam strength [GRI, 1994a; 1994b]. The anchor trench appears to have been a factor in both the initiation and propagation of the tear [Anderson and Kavazanjian, 1995; Augello et al., 1995]. No disruption of the underlying low permeability soil liner was reported in either case.

Cracking of cover soils and downslope movement of the waste mass were also observed at the Chiquita Canyon Landfill following the earthquake. The downslope movement was most pronounced in an area where a smooth geomembrane was used at the base of the landfill. Neither the Lopez Canyon Landfill nor the Bradley Avenue Landfill employed smooth geomembranes at the base of the lined areas.

Matasović et al. [1995] report that, as in other earthquakes, the most prevalent damage to landfills in the Northridge event was superficial brittle cracking in cover soil at transitions between waste fill and natural ground areas. Cracks were typically 0.4 to 2.8 in. (10 to 70 mm) wide and of similar vertical relief. The most pronounced cracking of this type was at the Sunshine Canyon Landfill, the closest landfill to the zone of energy release from the earthquake. At the Sunshine Canyon facility, located approximately 4.4 miles (7 km) from the zone of energy release and subject to free-field bedrock ground motions estimated to be as great as 0.52 g, the observed cracks were approximately 1 ft (300 mm) in height and width near the contact between the refuse fill and the canyon wall at the back of the landfill. This cracking can be attributed to the differential dynamic response of the waste fill and the natural ground and, possibly, earthquake-induced settlement of the cover soil and/or refuse.

As in previous earthquakes, disruption to landfill gas recovery systems was common during the Northridge earthquake. Loss of power was perhaps the most common source of disruption, followed by breakage of gas and condensate lines and well heads. In all cases, gas recovery systems were repaired by landfill maintenance personnel without disruption to landfill operations and were back in operation within 24 hours.

Augello et al. [1995] report on back analyses of solid waste and liner interface shear strengths from observations of the behavior of the Chiquita Canyon and Lopez Canyon landfills in the Northridge earthquake. The analyses were conducted using a range of dynamic material properties believed to bracket the actual properties existing in the field. The range of properties resulted in a range of back calculated solid waste

and liner interface shear strengths. For the Chiquita Canyon Landfill, where earthquake induced displacements of up to 12 in. (300 mm) were observed, the back analyzed shear strengths are considered to represent the actual shear strengths mobilized during the earthquake. Back calculated friction angles along the smooth geomembrane-soil interface on the base of Area C at Chiquita Canyon varied from 10 degrees to 16 degrees, while back calculated shear strength for the solid waste in Area C varied from 34 degrees to 44 degrees, depending on the assumed material properties.

At the Lopez Canyon landfill, where no permanent seismic deformation along a liner system interface or within the waste mass was observed, back calculated shear strengths may be considered to represent a lower bound on the available shear strength. The analysis yields the minimum strength required to maintain stability. The available strength may actually exceed this minimum value. The analyses of Disposal Area C at the Lopez Canyon Landfill yielded mobilized friction angles of 20 degrees to 25 degrees for the textured liner compacted clay interface and mobilized friction angles of 35 degrees to 54 degrees for the solid waste.

4. IMPLICATIONS OF OBSERVATIONS OF SOLID WASTE LANDFILL PERFORMANCE IN RECENT EARTHQUAKES FOR DESIGN OF THE EAGLE MOUNTAIN LANDFILL

4.1 Introduction

Observations of the performance of solid waste landfills in recent earthquakes can provide insight into the appropriateness and degree of conservatism of the seismic performance assessment of the Eagle Mountain Landfill in both a qualitative and quantitative manner. Qualitatively, observations of the performance of solid waste landfills in recent earthquakes indicate that these facilities can withstand strong ground motions similar in magnitude and intensity to those established on a conservative basis for design of the Eagle Mountain Landfill. Qualitatively, solid waste and liner system interface shear strengths back calculated from observations of landfill performance in the Northridge and other earthquakes provide direct evidence that the shear strength parameters used in the seismic performance analyses conducted for the Eagle Mountain Landfill are conservative.

4.2 Qualitative Observations of the Performance of Landfills in Earthquakes

Despite numerous landfills subjected to strong shaking in large magnitude earthquakes, there is no recorded incident of significant damage resulting in a release of contaminants to the environment from a landfill because of seismic loading. This record of performance includes geosynthetic-lined landfills in the epicentral region of the Northridge event constructed in compliance with Subtitle D regulatory requirements. The most common form of damage observed at solid waste landfills in earthquakes is cracking of interim cover soils and temporary disruption of the landfill gas collection system. Disruption to the gas collection system is frequently associated with loss of power and is easily mitigated by installation of an emergency generator. The cracking of cover soils is typically hard to distinguish from cracking that develops under

"normal" operating conditions and is repairable using standard landfill maintenance procedures. This includes landfills with waste slopes as steep as 2H:1V subject to free field ground motions in excess of 0.50 g from a M 7.1 earthquake. In virtually every case, the limited damage was repaired within 48 hours by landfill staff using equipment and materials available on site with little to no disruption in landfill operations. Based on this very good record of performance, the 3H:1V waste slopes proposed for the Eagle Mountain Landfill should perform in a satisfactory manner if ever subjected to a 0.56 g PGA from the conservatively-established M 6.0 to 6.5 design earthquake.

The performance of the Lopez Canyon and Bradley Avenue Landfills in the Northridge earthquake provide direct evidence that landfills designed in accordance with current standards can withstand strong ground motions similar to those for which the Eagle Mountain Landfill was designed. The magnitude of the Northridge earthquake was slightly larger than the magnitude of the prescriptive Subtitle D design event for the Eagle Mountain Landfill and the Lopez Canyon and Bradley Avenue Landfills were only slightly farther from the epicenter of the Northridge event than the assumed epicentral distance for the Eagle Mountain design event. Both landfills performed very well during the Northridge earthquake, with no evidence of seismically-induced displacement between the waste mass and liner system.

There was damage to the geosynthetic liner system at the Chiquita Canyon Landfill in the Northridge earthquake, even though this landfill was located further from the zone of energy release and subject to ground motions calculated to be of lesser intensity than either the Lopez Canyon or Bradley Avenue Landfills. The tear in the liner system at the Chiquita Canyon Landfill is attributable to a combination of design and construction details, including stress concentrations located adjacent to anchor trenches and pre-existing cracks at locations where coupons were removed for laboratory tests during CQA activities. These effects can be mitigated by eliminating unnecessary anchor trenches and abandoning anchor trenches when the liner system is extended past the anchor trench limits and by the use of additional CQA procedures during liner system installation.

4.3 Quantitative Evaluation of Material Properties

Observations of the performance of the Chiquita Canyon and Lopez Canyon Landfills in the Northridge earthquake and of the OII Landfill during the Whittier Narrows earthquake allow for back-calculation of mobilized shear strengths along smooth and textured geomembrane interfaces and within the solid waste mass during earthquakes. Comparison of these back-calculated values to the values used in the design of the Eagle Mountain Landfill indicate that the Eagle Mountain Landfill design parameters provide a conservative basis for the seismic performance evaluation of the landfill.

Interface friction angles back calculated along a smooth geomembrane-soil interface in Area C at the Chiquita Canyon Landfill varied between 10 and 16 degrees, depending on the choice of dynamic material properties. These values are consistent with the value of 8 degrees assumed in design analyses for the Eagle Mountain Landfill. Interface friction angles back calculated for textured geomembrane-compacted clay interface at the Lopez Canyon Landfill varied between 20 and 25 degrees. These values indicate that the textured geomembrane interface shear strength of 14 degrees assumed in design analyses for the Eagle Mountain Landfill can be achieved and/or even exceeded in some cases. Interface friction angles for solid waste back calculated for both Lopez canyon and Chiquita Canyon varied between 34 and 54 degrees. These values indicate that the solid waste shear strength parameters of a friction angle of 28 degrees and a cohesion of 100 psf (5 kPa) used in seismic design analyses of the Eagle Mountain Landfill are conservative.

5. SUMMARY, CONCLUSIONS AND LIMITATIONS

5.1 Summary

Seismic design of the Eagle Mountain Landfill is described in the ROWD and ROWD-SV1 [GeoSyntec, 1992; 1993]. These documents show the project site to be an area of low seismicity that is not subject to active faulting. Observations of the performance of landfills in recent earthquakes indicate that the evaluation of the seismic performance of the landfill described in these documents is based upon conservative design assumptions and design parameters.

Geologic investigations performed for the project indicate that no active faulting has occurred in the vicinity of the site for at least several hundred thousand years and possibly for longer than 100,000,000 years. Seismological investigations were conducted for the project to provide input to site-specific seismic hazard analyses in order to establish seismic design criteria. The seismological investigations indicate that the Eagle Mountain Landfill is located at the eastern boundary of the zone of historical seismic activity in southern California.

Based upon the site-specific seismic hazard analysis, the prescriptive Subtitle D design event for use in design of the liner system for the Eagle Mountain Landfill was conservatively established as a M 6.0 to 6.5 event at a distance of approximately 5 miles (8 km) generating a PGA in lithified earth at the site of 0.56 g. Based upon site-specific analysis, the California MPE event for design of the landfill cover system was conservatively assessed as either a M 6.5 event generating a PGA of 0.22 g in lithified earth at the site or a M 7.8 event generating a PGA of 0.14 g in lithified earth at the site. The state and federal criteria provide a higher level of seismic loading than typically used for design of commercial and residential structures. The level of seismic loading established for the Eagle Mountain facility is comparable to seismic design loadings used for hospitals, schools, and other critical facilities.

Many, if not most, solid waste landfills in California are located in areas of higher seismicity than the Eagle Mountain Landfill. A significant number of these landfills have been subjected to ground motions comparable to the design ground motions established for the Eagle Mountain Landfill. Observations from recent earthquakes provide no evidence of significant damage to solid waste landfills resulting in a release of contaminants to the environment due to seismic shaking. The primary impact of strong ground motions on the performance of landfills in recent earthquakes has been cracking of cover soils and disruption of landfill gas collection systems. In virtually every case, repair of this type of damage has been completed within 48 hours by landfill staff using routine maintenance procedures with little to no disruption of landfill operations.

Observations of the performance of geosynthetic-lined areas at the Lopez Canyon and Bradley Avenue Landfills in the Northridge earthquake indicates that facilities designed in accordance with current State and Federal regulations can withstand strong ground shaking without damage to the liner system. Damage observed to the liner system of the Chiquita Canyon Landfill, subjected to ground motions of lesser intensity than either the Lopez Canyon or Bradley Avenue Landfills, indicate the importance of attention to details in design and construction of geosynthetic-lined landfills. Back-calculated shear strength parameters for geomembrane-soil interfaces and for solid waste developed from the observed performance of the Lopez Canyon and Chiquita Canyon Landfills in the Northridge event indicate that the design parameters used in the ROWD and ROWD-SV1 for seismic analysis of the Eagle Mountain Landfill provide a conservative basis for the assessment of seismic performance. Combined with the conservatively-assessed design ground motions, these back-calculated strengths indicate the proposed design for the Eagle Mountain Landfill provides a high degree of protection against seismic upset.

5.2 Conclusions

The record of performance of solid waste landfills in recent earthquakes is excellent. The performance of the geosynthetic-lined landfills at Lopez Canyon and Bradley Avenue in the Northridge earthquake indicates that facilities designed to Federal Subtitle D regulatory standards are capable of resisting strong ground motions similar to the design motions for the Eagle Mountain Landfill. Mobilized shear strengths back-calculated for geomembrane-soil interfaces and for solid waste from the observed performance of landfills in the Northridge earthquake indicate that the shear strength parameters used in the ROWD and ROWD-SV1 for seismic analyses of the Eagle Mountain Landfill are conservative. The comprehensive approach to seismic design of the Eagle Mountain Landfill, coupled with the various conservatisms incorporated into the design, should cause this landfill to be very resistant to seismic upset and secure for any reasonably anticipated earthquake.

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Appendix H-3

Faults and Micro-Seismicity Investigations and Conclusions, Proposed Eagle Mountain Landfill Site

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FAULTS AND MICRO-SEISMICITY INVESTIGATIONS AND CONCLUSIONS, PROPOSED EAGLE MOUNTAIN LANDFILL SITE, RIVERSIDE COUNTY, CALIFORNIA

by

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for

Mine Reclamation Corporation
Palm Springs, California

November 1992

(Updated May 1993)

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INTRODUCTION

The proposed Eagle Mountain Landfill and Recycling Center is located at an inactive open pit iron mine, formerly operated by Kaiser Steel Corporation, located about 40 miles east of Indio in Riverside County (Fig. 1). State of California and Federal regulations require that Class III non-hazardous solid waste landfills not be located within 200 feet of a known active fault. An active fault is defined as having moved within the Holocene epoch of geological time, that is, within about the past 11,000 years (Hart, 1992).

In August 1991, I was engaged by Mine Reclamation Corporation (Palm Springs, California) to investigate the Eagle Mountain site for evidence of active faulting. I found no evidence of active faulting at the site during that investigation.

The California Regional Water Quality Control Board (RWQCB) requested that the California Division of Mines and Geology (CDMG) provide a geologist familiar with faulting to inspect the site. On April 29 and 30, 1992, CDMG geologist William Bryant inspected the site, accompanied by me and by three RWQCB geologists, Robert Perdue, Richard Boylan and Liann Chavez. Mr. Bryant prepared a letter dated May 6, 1992, in which he recommended additional geologic investigations to obtain additional evidence related to possible Holocene faulting. Supplemental geologic investigations were performed in 1992 and 1993 to comply with Mr. Bryant's request.

This report summarizes my 1991 work and describes the 1992 and 1993 investigations performed at the site. This report also addresses comments from the California Integrated Waste Management Board (memorandum of August 1, 1992), and from the RWQCB (letter of April 27, 1993). Based on my work and the results of the supplemental investigations, it is my

professional opinion that there are no Holocene faults at the proposed Eagle Mountain Landfill site.

The geology of the Eagle Mountain Landfill site is shown on Plates 1 and 2, contained in the December 1992 Eagle Mountain Landfill Report of Waste Discharge (ROWD). Plates 1 and 2 include a depiction of the faults and lineaments described in this report and should be referred to when reviewing this report.

The reader is directed to a companion report prepared by Quaternary Geologist Dr. Roy Shlemon (1993), which primarily addresses geomorphic and soil-stratigraphic dating techniques, and the results of applying these techniques to the proposed Eagle Mountain Landfill site. Dr. Shlemon's analysis provides further scientific evidence that there is no Holocene faulting at the Eagle Mountain site.

FAULT INVESTIGATIONS

Background

Separate fault investigations were made in 1991, 1992 and 1993. The 1991 fault investigations included: (1) a literature search and review of more than twenty published and unpublished references (q.v.) on the geology of the site area and on desert processes; (2) lineament analyses of stereoscopic aerial photographs flown in 1954 and 1981; and U-2 high altitude infra-red images taken in 1984; (3) field mapping with the assistance of GSi/water geologists; (4) assessment of anomalies from gravity surveys; and (5) evaluation of regional and local seismicity.

The 1992 investigations included: (1) excavating and logging of two trenches emplaced across projections of mapped faults; (2) plotting of fault-related geomorphic annotations onto a map, based on stereo air-photo interpretation; (3) soil-stratigraphic dating of alluvial sediments by Dr. Roy J. Shlemon (Dr. Shlemon's report is included in this ROWD); (4) analyses of newly discovered pre-mining air photos flown in 1936, 1944 and 1946; and (5) evaluating local micro-seismicity.

The 1993 investigations included: (1) detailed mapping of the relation of dikes and faults; and (2) logging of the walls of an arroyo about 3000 feet south of the proposed landfill boundary, where a projection of Fault "A" may extend.

Site Lineaments and Faults

Four major lineaments have been identified at the site; three are known bedrock faults designated as "East Pit", "Bald Eagle Canyon", and "Fault A". The fourth lineament, identified herein as "Lineament B", was observed on air photos and in the field for a distance of about one-half mile extending northwesterly from the northern footprint of the proposed landfill (Plate 2). "Lineament B" shows no evidence of faulting; rather this portion of the lineament is shown to be the result of differential erosion along joints in the bedrock; it is discussed later in this report.

Pre-mining Aerial Photographs

Pre-mining stereo air photographs from 1936 and 1946 were located at the Whittier College Fairchild Aerial Photography Collection. In addition, stereographic aerial photos from 1944, 1954 and 1956 were discovered in files at Kaiser's office at Eagle Mountain in 1992.

These early photos are extremely important because alluvium that overlies the Bald Eagle Canyon fault, the East Pit fault, and the southern part of Fault "A" (see Figs. 2, 10, 11 and 12), that subsequently has been disturbed by mining activities, is visible. These aerial photos show that the old alluvial surfaces are without lineaments and are characterized by well-patinated desert pavement indicating geomorphic stability for at least the past 100,000 years (Shlemon, 1993).

The air photos studied were:

DATE FLOWN	FLIGHT NUMBER	FRAME NUMBERS
10-25-36	C-4212	12-15, 19-22
02-16-44	20022	19E: MA3-3, 3-4, 3-5
11-26-46	C-10914	2: 1-5, 21-27, 50-54, 75-79
11-02-54	C-21080	2 stereo pairs
11-19-54	C-21180	1: 1-4, 20-26, 43-57, 80-85, 112-117
10-11-56	C-22635	1: 15-17, 33-39, 47-51
03-31-81	810308	Kaiser Eagle Mtn. Mine by Cooper Aerial
08-23-84	331405	217: 103-107, 115-116 (USAF U-2)

Geomorphic Assessments

Geomorphic and physiographic features along faults have been identified on the referenced air photos. Such features may be obvious or subtle. I reviewed these photos for lineaments, escarpments, truncated ridges, offset lithology, linear drainage, tonal changes, and unusual saddles and notches. Many of these features can be seen along bedrock faults that cross the footprint of the proposed landfill. The character of these features at the Eagle Mountain site are indicative of ancient faults. Two other linear features were studied by stereo air photos: an east-west lineament south of the proposed site, and the northwest-trending "Lineament B", which is

discussed later.

By noting the lineaments seen on air photos and comparing them to each known fault, one can get a general comparison of the relative ages of the lineaments. (My qualifications for stereo aerial photo interpretation and trench logging experience are appended.) The relative fault activity has been determined by soil-stratigraphic dating of the overlying alluvium for Fault "A", the East Pit fault, and four splays or branches of the Bald Eagle Canyon fault (Shlemon, 1993). Thus, combining air photo assessments with field dating techniques, the relative ages of the three major faults observed at this site have been estimated and are reported by Shlemon (1993). Based on interpretation of pre-mining aerial photos and on field mapping and observations, there is no evidence of fault movement during Holocene time.

Soil-Stratigraphic Age Assessments

The age of Quaternary sediments in and near the proposed Eagle Mountain Landfill was assessed by Dr. Roy Shlemon (1993) using geomorphic and soil-stratigraphic dating methods. Dr. Shlemon examined the unbroken Quaternary sediments that overlie the East Pit fault, the Bald Eagle Canyon fault, and Fault "A", as exposed in old mine excavations and in trenches emplaced in alluvium across projections of the faults.

The East Pit exposures were particularly useful for soil-stratigraphic age assessments (Figs. 3 and 4). Here, more than 270 feet of Quaternary alluvium, mudflows and debris flows are replete with buried and relict paleosols that can be dated by relative soil profile development. Accordingly, because of the excellent exposure of the East Pit datable paleosols, soil-stratigraphic dating proved to be much more effective in assessing fault activity than other relative or numeric

dating techniques that have inherently large sampling uncertainties.

Based on geomorphic expression and on soil-stratigraphic dating, Dr. Shlemon determined that the unbroken Quaternary sediments overlying the East Pit fault are probably more than 100,000 years old; and those overlying the Bald Eagle Canyon fault and Fault A, respectively, are of comparable antiquity.

East Pit Fault

The East Pit fault trends N 40° to 50°W where it is well exposed on the mining benches at the north rim of the East Pit (Plate 2). There it dips 80°NE and reveals a 30-foot thickness of gouge and crushed rock. In general, the East Pit fault exhibits a thickness of 20 to 50 feet of crushed bedrock. At the southern part of the East Pit, the fault is overlain by at least 270 feet of old alluvium. Inspection of this old alluvium by Dr. Shlemon (1993) indicates that it is older than 100,000 years and is unbroken by the fault. Thus, the East Pit is a man-made "trench" that exposes a remarkable fault/alluvium contact better than a typical geologic trenching operation. This exposure is the strongest evidence that the East Pit fault is pre-Holocene.

Bald Eagle Canyon Fault

Trench No. 1 Exposures. Trench No. 1 is located immediately south of the southwest rim of the East Pit (Plate 2 and Fig. 7). It is about 815 feet long, 4 to 15 feet wide, and is 8 to 14 feet deep. It was excavated in July 1992 by a D-9 tractor and a Hyundai backhoe, later partly deepened and extended eastward, at the suggestion of the RWQCB. The trench is separated into two reaches because of a large pile of excavation spoil near midway. Trench No. 1 was located

to cross any buried trace or traces of the Bald Eagle Canyon fault. In contrast to the straight trace of the fault extending northwest in Bald Eagle Canyon, southward the fault becomes a zone of several distinct splays, or branches. Bedrock exposures adjacent to the trench (both to the north in the East Pit and to the southeast in an old Kaiser cut) reveal five branches of this fault, as shown on Plate 2 and Figure 5. For convenience, these branches of the Bald Eagle Canyon fault zone have been numbered. (Fault branch "6" (Plate 2 and Fig. 6) may be a splay off of Fault branch "2".)

The western 290 feet of Trench No. 1 were inspected on July 27, 1992, by Dr. Shlemon, RWQCB geologists Richard Boylan and Liann Chavez, and me. I logged the trenches on July 28, and the extension of Trench No. 1 on August 5, 1992, at a scale of one inch equals 10 feet (see Log, Figs. 24 and 25).

Of particular importance is that Trench No. 1 shows the horizontal contact between the recent and older alluviums (Qal_1 over Qal_2 on logs, Figs. 24 and 25) to be unbroken (e.g., Fig. 8). Holocene faulting would have disrupted this contact; however, no disruption or faults were evident. In addition, a crude but distinct gravel layer (and layers) lies just below the top of the Qal_2 unit, and, although locally discontinuous, appears to be unbroken.

Near Station 215 (Fig. 24) a 6-foot-wide Qal_1 scour channel has eroded the Qal_2 unit; a search for any fault-indicator sign, such as near-vertical disturbance of sand grains, showed no evidence of faulting. Of note is a red-soil horizontal marker bed that occurs at the same elevation on each side of the channel, likewise indicating no evidence of faulting at this location.

To the east, the Qal_2 unit ends by depositional lapping against the bedrock at Station 500. East of here, extending to the end of the trench at Station 815, Kaiser's mining operations

stripped all alluvium off the basement rock. A branch of the Bald Eagle Canyon fault is exposed in the trench bedrock, but four of the branches are even better exposed immediately south of the trench in a near vertical exposure resulting from an old Kaiser cut. The attitudes of these branches are shown on Plate 2, and range from bearings N25° to 50°W, with dips of 75°NE to vertical. Fault branches 1 and 2 project from bedrock exposed in the north side of the East Pit to underlie the alluvial part of Trench No. 1. Fault branch 5 lies east of Trench No. 1, but is well exposed in the old Kaiser cut where a thin undisturbed mud flow deposit overlies the fault. This mud flow appears similar to those exposed so well in the eastern part of the East Pit, where Dr. Shlemon (1993) has indicated pre-Holocene ages for the uppermost layers.

East Pit/Southwestern Rim Exposures. The south rim of the East Pit is only 100 feet north of Trench No. 1. Five main branches of the Bald Eagle Canyon fault (Plate 2 and Fig. 5) are also exposed in the bedrock in the south wall of the East Pit. Four of the branch faults are overlain by older alluvium, which is 30 to 120 feet thick. Field inspection of the older alluvium above the faults shows no indication of disturbance. This older alluvium is lower in the section, and thus, older than the pre-Holocene Qal_2 alluvium exposed in the bottom of nearby Trench No. 1.

The relative antiquity of the Bald Eagle Canyon fault is also indicated by the following facts: (1) the fault does not disrupt the older alluvium-patinated fan surfaces in the East Pit, as seen on pre-mining air photos (see Figs. 2 and 10); and (2) nowhere can it be observed in the field, or on air photos, that dikes have been offset by this fault.

Fault "A"

Trench No. 2 Exposures. Trench No. 2 (see Log, Fig. 26 and Plate 1) was excavated across the southerly projection of the northwest-trending Fault "A". In addition to strong topographic expression on air photos, Fault "A" is well exposed in a saddle 3,000 feet north of Trench No. 2 (see Plate 1), where gouge strikes N 22°W and dips 85°SW. However, south of Trench No. 2, the topographic expression on air photos is weak to nonexistent. The trench is about 270 feet long, averages 6 feet deep, and is located on an old alluvial fan. Pre-mining air photos show that the fan surface is unbroken. Dr. Shlemon estimates the fan surface to be older than 40,000 years. Mr. Boylan, Ms. Chavez, Dr. Shlemon and I inspected this trench on July 27, 1992. The fan materials exposed in the trench are randomly distributed with lenses of horizontal sediments (sand, silt and gravel). These lenses are continuous over lengths of about 10 to 30 feet, and therefore preclude the possibility of proving that offsets of a few inches or less have not occurred. However, no near-vertical disruption of sand grains, or any other fault-indicator features, were observed. Dr. Shlemon's report (1993) provides additional comments concerning the age of the unbroken fan deposits in Trench No. 2.

A bedrock fault south of the trench reveals an 18-inch thickness of crushed quartzite that strikes N 55°W and dips 74°SW. This fault may be related to Fault "A"; however, it too does not disrupt the overlying old alluvium as seen in the nearby stream banks between here and Trench No. 2. Figure 12 (Air-photo 3) shows that the pre-mining surface of the alluvial fan 3,000 feet southwest of Trench No. 2 is unbroken. No offset was observed in the well-exposed horizontal gravels in the banks of a nearby stream channel, which is discussed below.

The age of injection of the volcanic dikes has been conjectural. The Miocene Epoch (5

to 22 million years ago) was a time of abundant volcanic activity in southern California. However, Hope (1969), suggested these dikes could be of the Cretaceous Period (65 to 124 million years ago). Newly acquired K-Ar age-dating of the dikes is discussed in detail in the ROWD Supplemental Volume 1, June 1993. The results of the age-dating indicates that the dikes are older than 120 million years.

Southeastern Extension/Arroyo Exposures. At the request of Mr. Bryant in his letter of May 6, 1992, I inspected a dry wash (arroyo) on August 5, 1992 (termed Locality 2 on Bryant's Fig 1, in his 5/6/92 letter), in an attempt to find evidence of a southeastward extension of Fault "A". Figure 13 shows the location of this arroyo, 3,000 feet south of the proposed landfill, where a projection of Fault "A" would cross, if it existed here. I found no evidence of faulting in the fanglomerate and granitic rock exposed in the arroyo. To better document this, on May 14, 1993, I logged the walls of the arroyo and took photographs of much of the exposed walls. The logs (Figs. 27 to 33) are keyed to the ten representative photos (Figures 14 to 23), and are included herein, comprising seven sheets.

The arroyo is essentially east-west trending and extends 1,700 feet eastward from the granitic rock at the base of the hills, and its banks, or walls, are mostly about 20 feet high. The exposed fanglomerate (Qf on logs) is locally covered with old fill and debris from Kaiser's mining operations. Although this artificial fill obscures a large part of the northern wall of the arroyo, this is compensated by good exposures on the southern wall, so that any projection of Fault "A" would be exposed in the arroyo walls. The lithology and stratigraphy of the fanglomerate are such that overlapping horizontal beds and lenses extend the length of the arroyo, even though any one bed may not extend for more than a few tens of feet. The fanglomerate

beds consist of boulders, cobbles, pebbles, sand and silt in various combinations and in various thicknesses and lengths (see photos). The finer-grained beds are generally easier to see subtle offsets of layers that may exist. Granitic bedrock is exposed for about 450 feet in the arroyo in several places, or for about 25 percent of the total length. The bedrock is fractured and jointed, but no faults were seen.

The conclusion for Fault "A" at this locality is that it apparently dies-out northwest of this arroyo. This is supported by: (1) the weak lineaments seen on the air photos in the nearby hills, as compared to the well-defined fault lineaments farther north; (2) the lack of disruption on the nearby fan surface as seen on pre-mining air photos (e.g., Fig. 12); and (3) the lack of evidence of faulting in Trench No. 2 and in this arroyo.

"Lineament B"

This feature, shown on Plate 2, is a northwest-trending lineament best observed on air photos. Mr. Bryant suggested this feature be termed "Fault B", but noted apparently undisturbed alluvium in air photos in a linear canyon about two miles north of the site footprint. I agree that the air photos show undisturbed alluvium there. My original review of the air photos indicated that the features expressed on the air photos are indicative of old faults, that is, subdued topographic lineaments rather than sharply defined lineaments. Additional geologic field mapping was performed in May 1993 in the canyon extending northward beyond Plate 2 by Dr. Joseph Birman and Mario Real, both from GSi/water, and me. This additional mapping confirms the earlier observation that there is no evidence of faulting in the granitic outcrops where, if "Lineament B" were a fault, it should be exposed. Accordingly, it is our opinion that "Lineament

B" is not a fault, but a linear canyon that formed along strongly jointed granitic rock. In addition, projection southeastward of this lineament shows no disruption of older alluvial fan surfaces on air photos.

Off-Landfill Site Vicinity Faults

General. Three nearby faults were studied that are not within the proposed site footprint, but have been mentioned by others as possibly significant to the proposed facility. These faults are the Substation fault, located three miles south of the site, the Victory Pass fault, located six miles south, and the Blue Cut fault, located four miles north of the site (see Fig. 1). The seismogenic characteristics of these faults are discussed in a 1992 report by Geoffrey R. Martin prepared for this ROWD.

Substation and Victory Pass Faults. These two east-west faults are each about 11 miles long, and are three and six miles south of the footprint of the proposed landfill site, respectively. Hope (1969) and Powell (1981) have studied these two faults extensively. Both suggest that, because they parallel the much longer potentially active Blue Cut fault (Fig. 1), then these two faults may be potentially active as well.

It may be of interest that the MWD Eagle Mtn. Pumping Plant is situated directly on the Substation fault. This is a very critical facility, that along with four other pumping plants, supply water to 16 million people. When it was sited in the early 1930s, little was known about the smaller faults in the desert. Nonetheless, the pumping plant has operated uneventfully for almost 60 years.

Blue Cut Fault. The Blue Cut fault extends east-west for 50 miles, and is four miles

north of the site at its closest point (Fig. 1). The western half of the fault, between the Dillon fault in the upper Coachella Valley and the western Pinto Basin, is considered potentially active by the CDMG (1992). The eastern half, extending eastward to its termination at the Sheep Hole fault, has been considered inactive. However, examination of aerial photos along the north base of the Eagle Mountains reveal apparent abrupt termination of old patinated fan surfaces in an east-west direction. The terminated fans extend for about 6,000 feet. An eastward projection of this east-west line encounters another old fan which appears on the air-photos to be undisturbed. Crippen and Spencer (1984) suggest that the alluvium surface to the west in Pinto Basin is broken along the Blue Cut fault, based on satellite imagery. These features may represent late Pleistocene movement along a short length of the eastern Blue Cut fault.

MICRO-SEISMICITY

Dr. Gary Fuis, a geophysicist with the U.S. Geological Survey, has studied micro-seismicity and small earthquakes (e.g., Fig. 9) in the eastern Transverse Ranges since he observed some Kaiser Iron Mine blasts in the mid-1970s. In discussions in February 1992 with me, Dr. Fuis said that a plot of earthquakes less than magnitude 3 over the years appear to form east-west alignments along the Blue Cut, Substation and Victory Pass faults (Fuis and others, 1978). Most of these earthquakes are too small to be felt by humans. These east-west alignments imply minor seismic activity at depth along these three faults. However, only the Blue Cut fault is long enough to generate strong ground accelerations at the site. The probabilistic seismic design parameters of the site are included in the 1992 report by Dr. Geoffrey R. Martin, prepared for this ROWD report.

The epicenter of the Landers earthquake of June 28, 1992 (M 7.4) was more than 50 miles distant. After the quake, Dr. Shlemon and I inspected the paved access road to the MWD Eagle Mtn. Pumping Plant, which crosses the buried Substation and Victory Pass faults. Paved roadways are excellent indicators of surface fault rupture because they are a brittle skin on the ground surface. No rupture was found across this road, as none was expected, for the epicenter was more than 50 miles away and would have yielded very low shaking at the landfill site. In a discussion with MWD surveyors at the Pumping Plant, no disturbance of any kind was observed by them.

CONCLUSION

This site is particularly unique in that a man-made "trench" exists (the open pit mine) which is about two miles long and as much as 1,000 feet deep, that clearly exposes the relation of bedrock faults and alluvium. *Unbroken pre-Holocene sediments directly overlie bedrock faults within the proposed Eagle Mountain Landfill site.* Based on geologic field mapping, trench logging, aerial photo analysis, and geomorphologic relationships, plus soil stratigraphy analysis by Dr. Shlemon (1993), it is my professional opinion that there is no evidence of Holocene faulting at the Eagle Mountain Landfill site.

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APPENDIX 5.3 C

Qualifications of Richard J. Proctor

Richard J. Proctor is a consulting engineering geologist specializing in faulting, landslides, heavy construction, tunnels, dams, and providing expert court testimony. He graduated California State University and UCLA, and was a Visiting Associate Professor of Geology at Caltech. From 1958 to 1980 he was employed with the Metropolitan Water District of Southern California (MWD) where he was Head of the Geology Branch for most of those 23 years. He is past-President of the Association of Engineering Geologists and past-President and Honorary Member of the American Institute of Professional Geologists.

Richard Proctor's training and experience in air-photo interpretation and trenching for faults includes employment as an air-photo interpreter for Fairchild Aerial surveys; graduation from the U. S. Army Corps of Engineers Cartography School at Ft. Belvoir, Virginia; air-photo interpretation work for his UCLA master's thesis covering the San Andreas and other faults in the upper Coachella Valley; as an employee of MWD, Mr. Proctor studied air-photo interpretation of faults and erosion along the Colorado River Aqueduct (which passes one mile east of the Eagle Mtn. site); he also inspected pipeline trench crossings of the Casa Loma Fault at San Jacinto, Elsinore Fault at Temecula, Mission Hills Fault at Sylmar, Mission Creek Fault at Desert Hot Springs, Newport-Inglewood Fault at Inglewood, San Jacinto Fault at Rialto, Sierra Madre Fault at Lakeview and Glendora, and the Whittier Fault at Yorba Linda.

Mr. Proctor taught air-photo interpretation as part of his Engineering Geology class when he was at Caltech. He participated in two U. S. Geological Survey grants to study air-photos and perform trenching of faults in the greater Los Angeles area--one grant with Lindvall-Richter &

Associates (prior to the passing of Dr. Charles F. Richter), one grant with Caltech. (The two USGS grant fault studies were published, see References of Crook and others, 1987, and Crook and Proctor, 1992.)

A partial list of projects where Mr. Proctor was a consultant on air-photo interpretation and trench logging follows, listed by client, project, fault and location:

Lindvall-Richter & Associates, El Bosque Project, Quito, Equador.

Lindvall-Richter & Associates, J. Paul Getty Museum, Malibu Coast Fault.

Lindvall-Richter & Associates/CH_2M Hill, Eagle River Dam, Alaska.

Blackhawk Corporation, housing tracts, faults and landslides within 3 sq. mile area, Blackhawk, CA.

Engeo Corporation, housing tracts, San Andreas Fault in San Bruno, Calaveras Fault in Danville, and Concord Fault in Concord, CA

National Medical Enterprises, hospital site, Pleasanton Fault, San Ramon, CA.

No. 1 Contracting Company, new airport, faults and construction materials, St. Thomas, Virgin Islands

Parsons-Brinkerhoff, proposed nuclear waste repository, Hanford, WA.

Santa Clara Valley Water District, Calaveras Dam, Calaveras Fault.

U. S. Geological Survey Grant with Caltech, Sierra Madre and Raymond Faults.

U. S. Geological Survey Grant with Lindvall-Richter, Hollywood and Santa Monica Faults.

U. S. Soil Conservation Service, fault studies for eight dams in Utah.

rjp\5.3

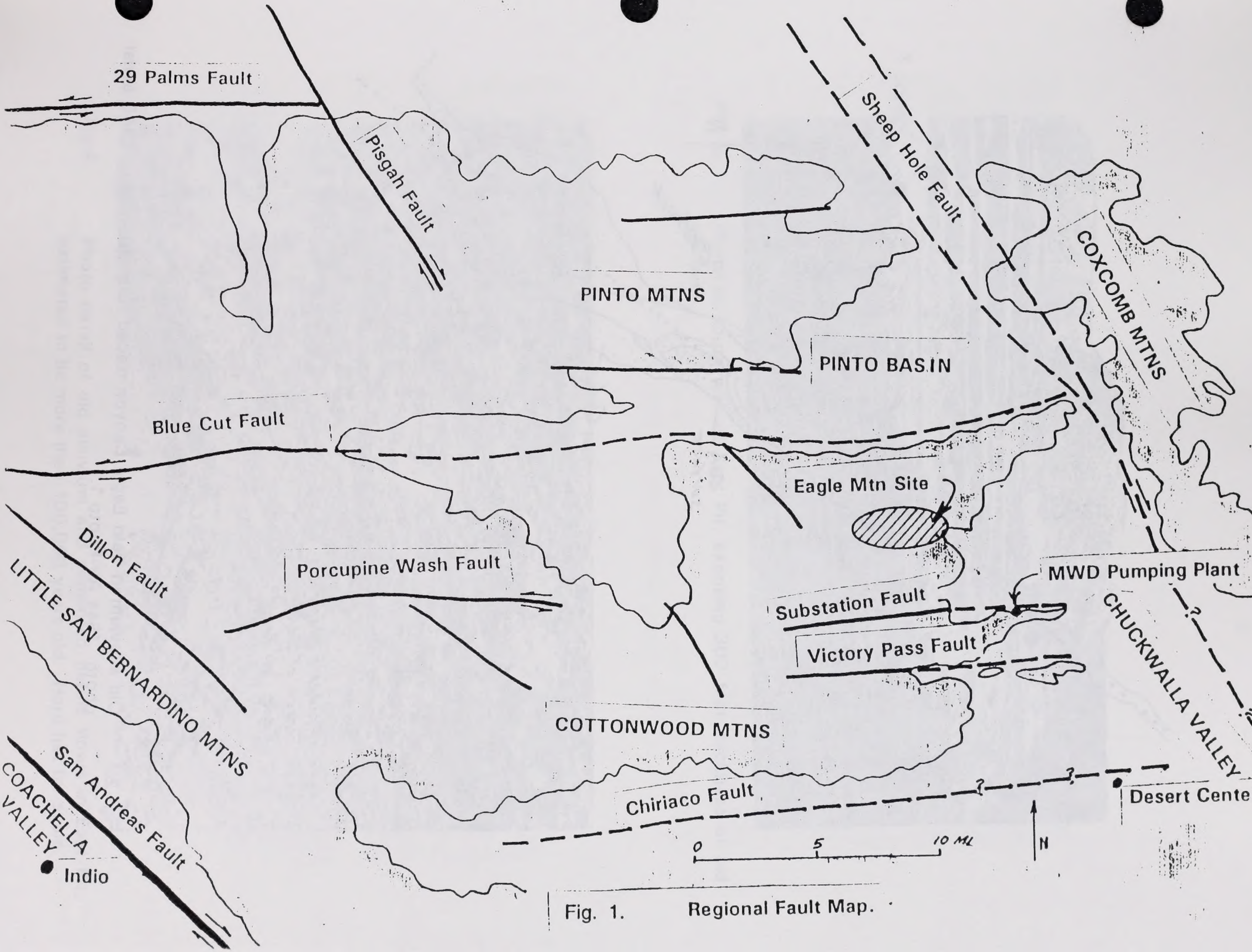


Fig. 1. Regional Fault Map.

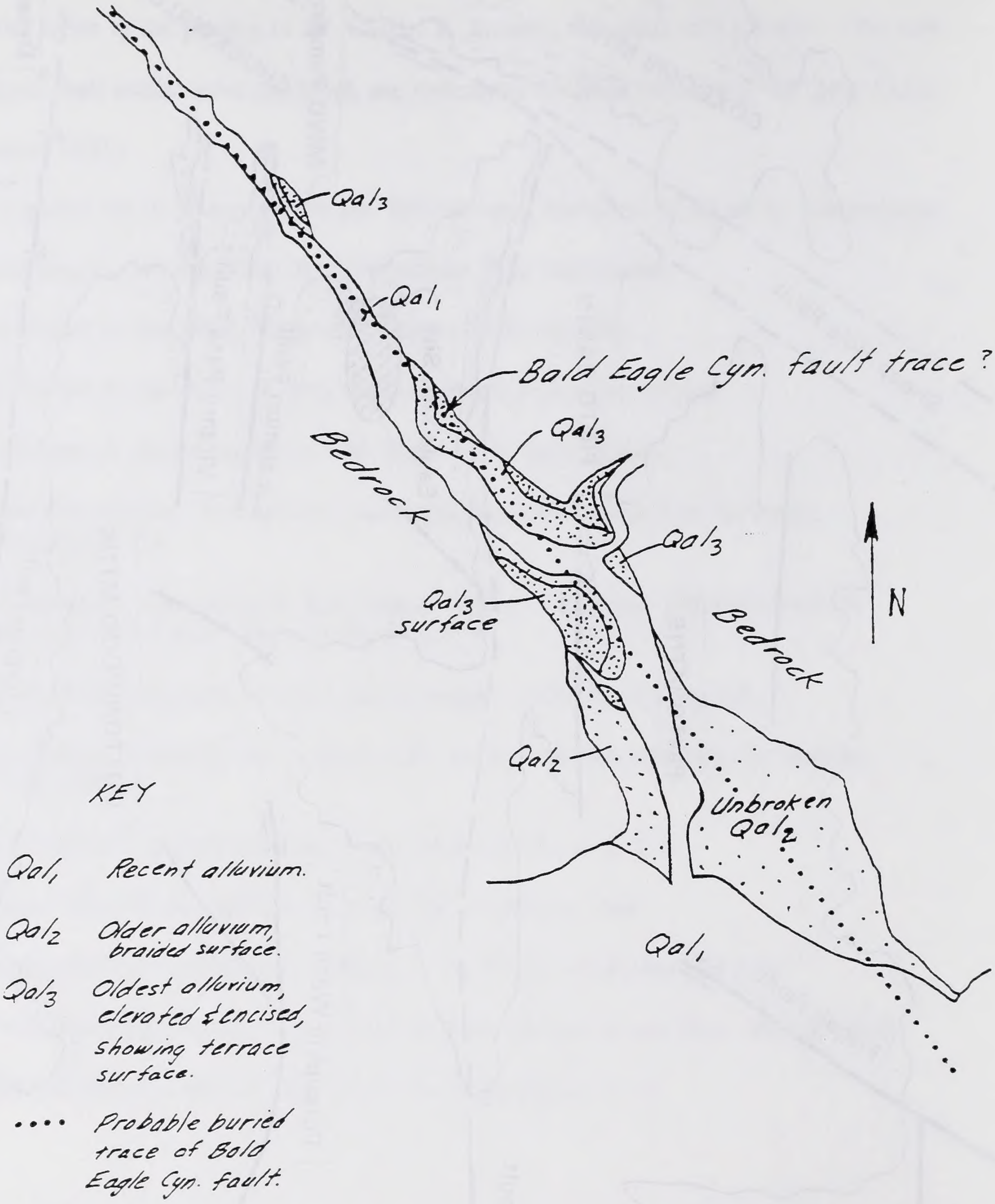


Fig. 2. Old alluvium in Bald Eagle Canyon traced from pre-mining 1946 aerial photo. (See Air-Photo 1.)

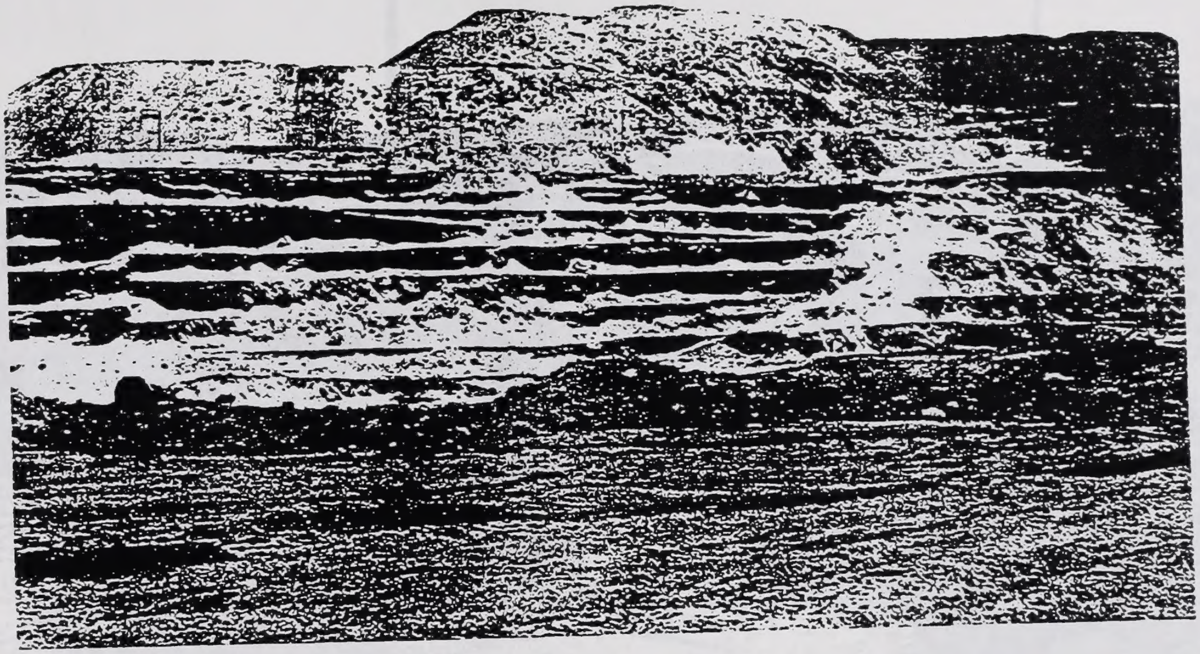


Fig. 3. Photo of south wall of East Pit, exposing 300 feet thickness of old alluvium.

Fig 4. Photo detail of old alluvium and cemented debris flows in East Pit, estimated to be more than 100,000 years old. Hard hat for scale.

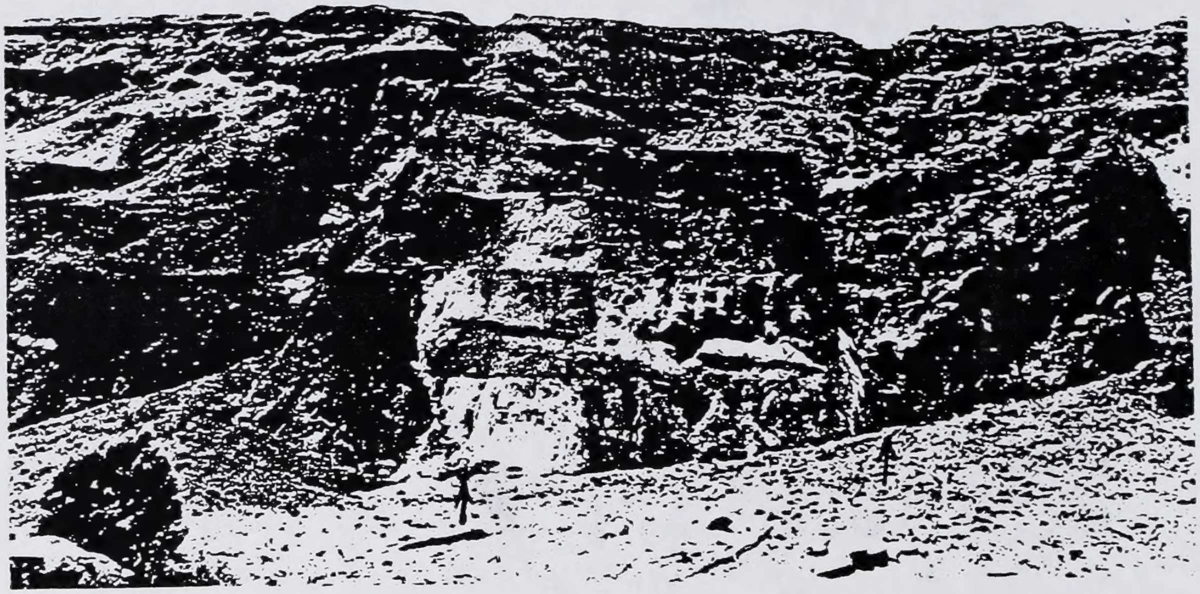


Fig. 5. Photo of South wall of East Pit showing two splays of Bald Eagle Canyon Fault (arrows point to faults "3" and "4" as shown on Plate 2).

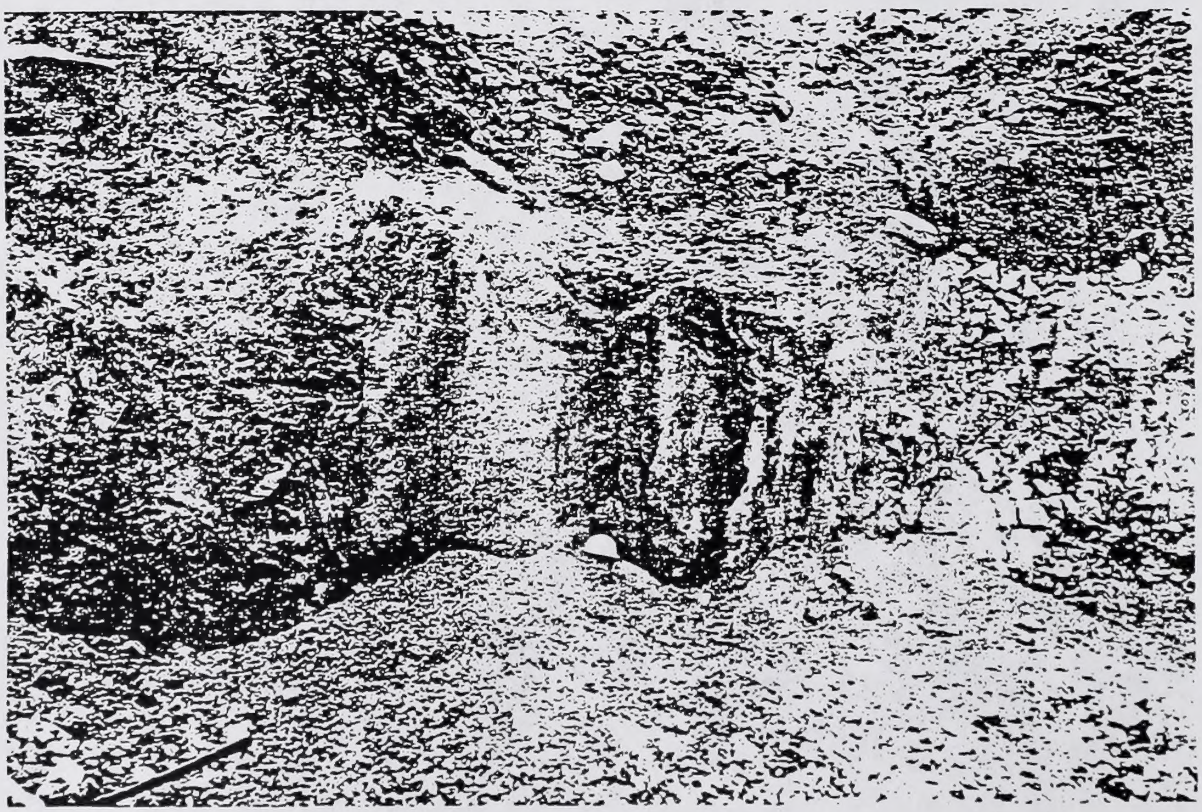


Fig. 6. Photo of Fault Splay "6" of Bald Eagle Canyon Fault (see Plate 1). The Fault is 14 feet wide consisting of crushed rock and gouge

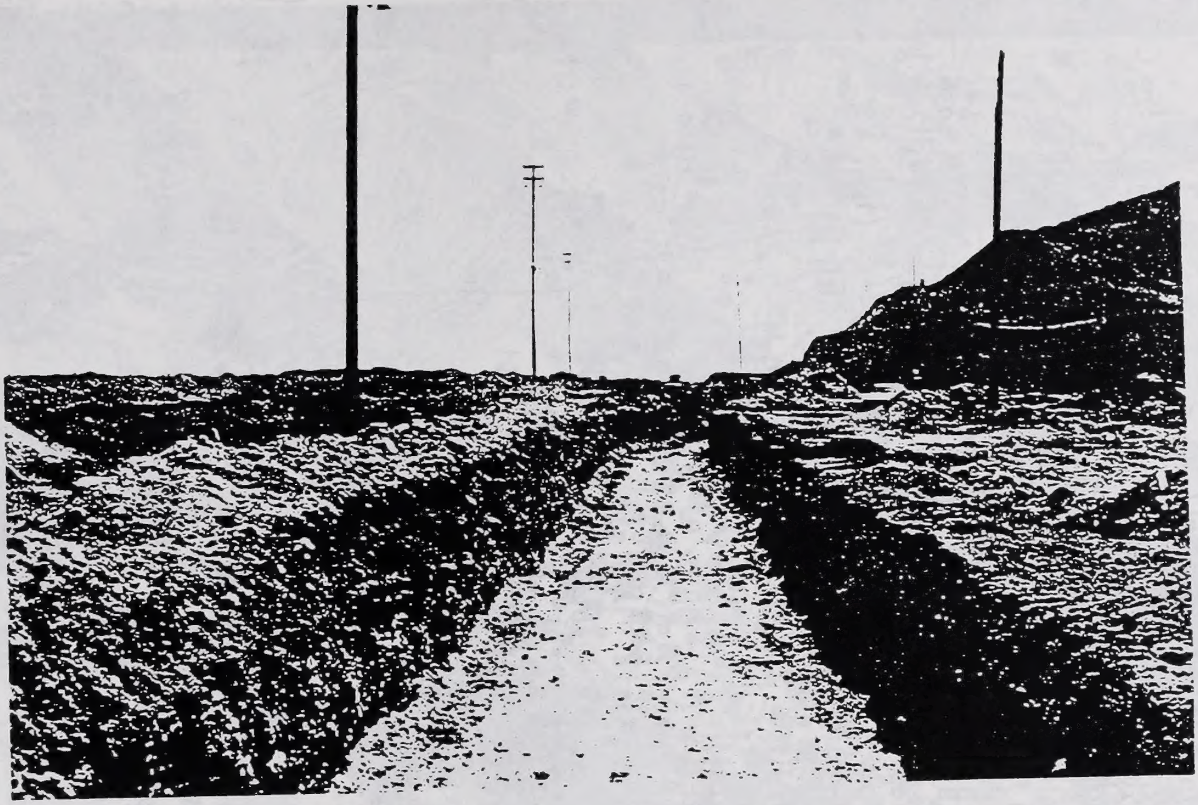


Fig. 7. Photo looking east of Trench No. 1, averaging 8 feet deep, 4 to 15 feet wide, and 815 feet long.

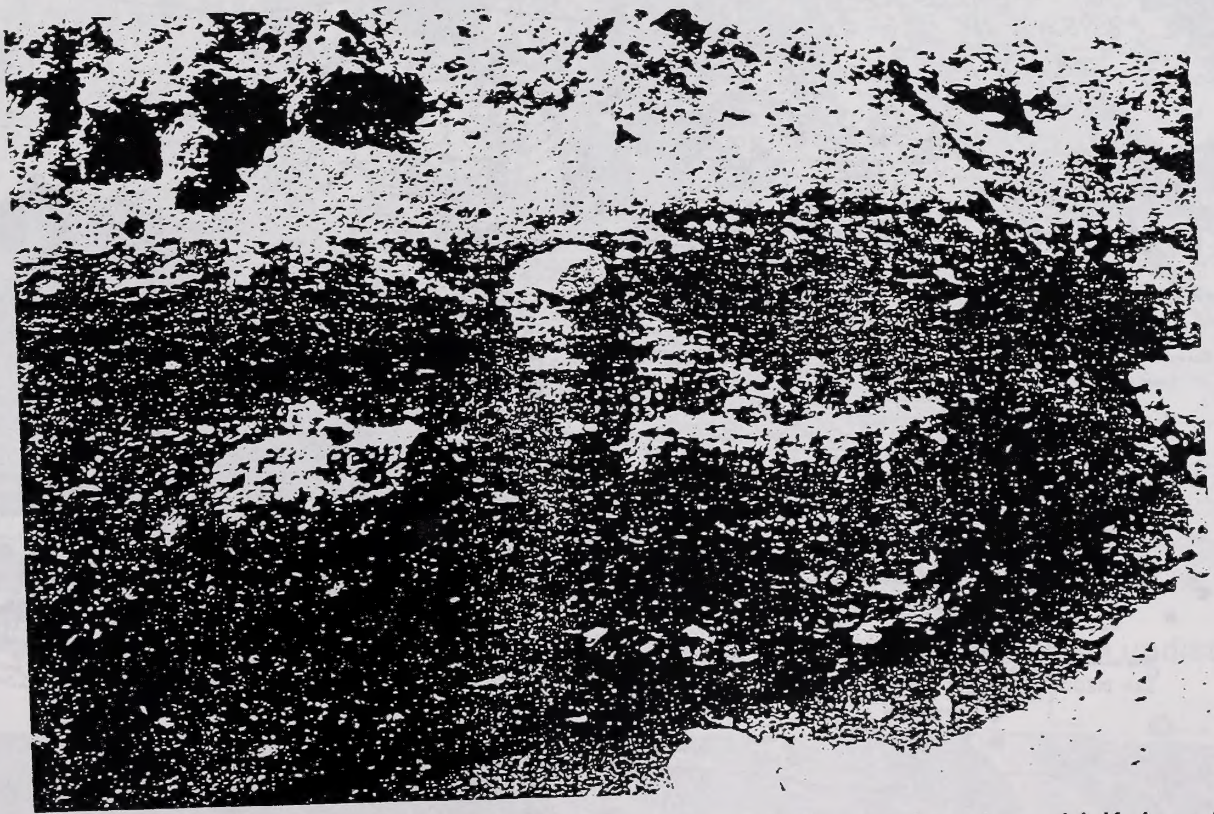


Fig. 8. Typical photo detail of wall of Trench No. 1 showing old Kaiser fill on gray Recent alluvium on red-brown pre-Holocene alluvium. No evidence of offset of horizontal layers was observed.

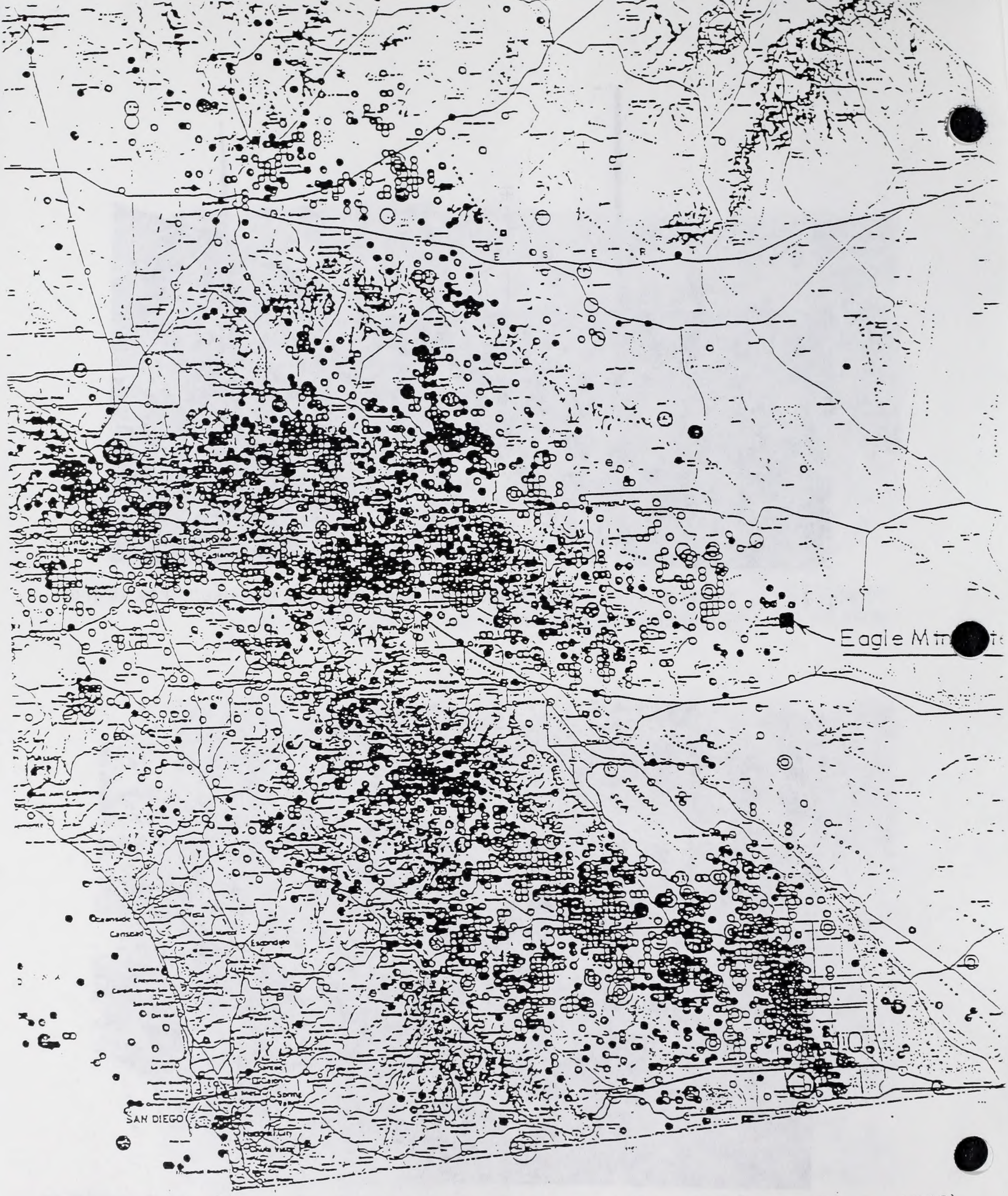


Figure 9. Earthquake Epicenters, 1808-1987 (From Goter, 1988)

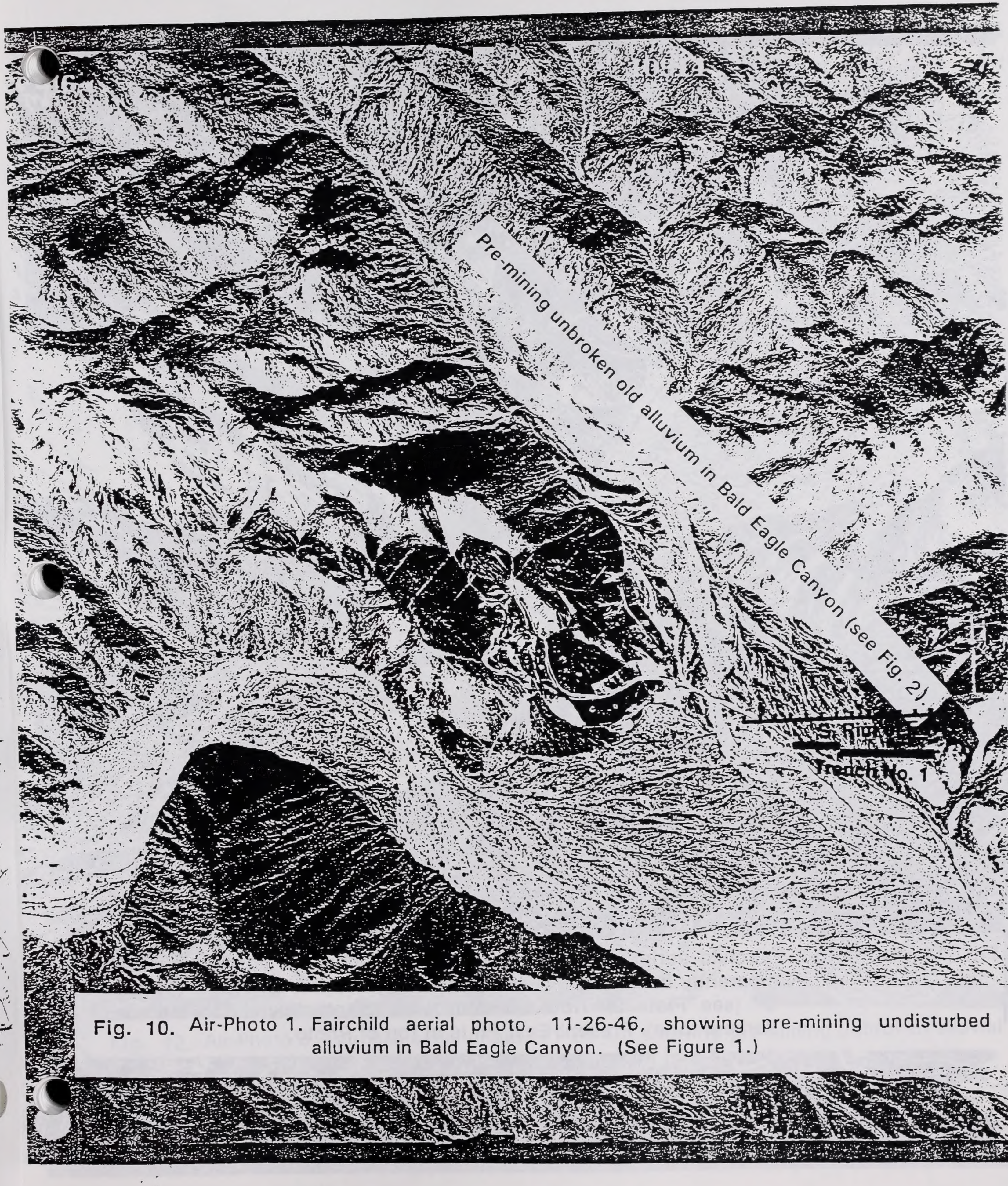
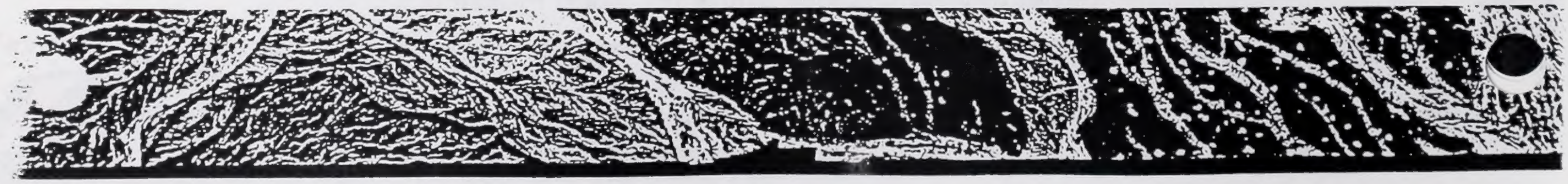


Fig. 10. Air-Photo 1. Fairchild aerial photo, 11-26-46, showing pre-mining undisturbed alluvium in Bald Eagle Canyon. (See Figure 1.)

Fig. 11. Air-Photo 2 Fairchild aerial photo, 11-26-46, showing now buried volcanic dike apparently not offset by Bald Eagle Canyon Fault splays "3","4" and "5" (see Plate 2). Note undisturbed ancient alluvial fan surfaces (darkest tone). Present East Pit is at top of Photo.



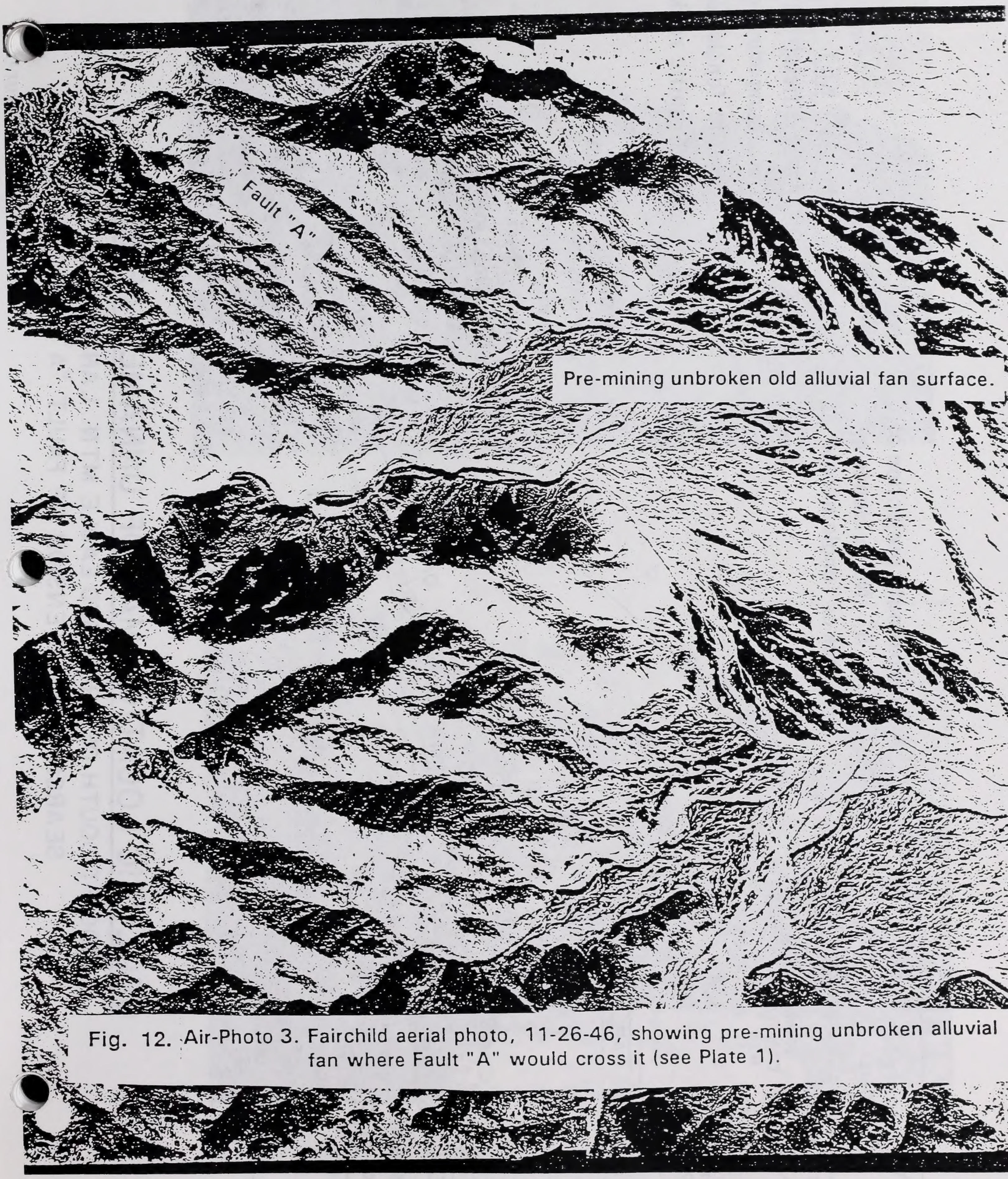
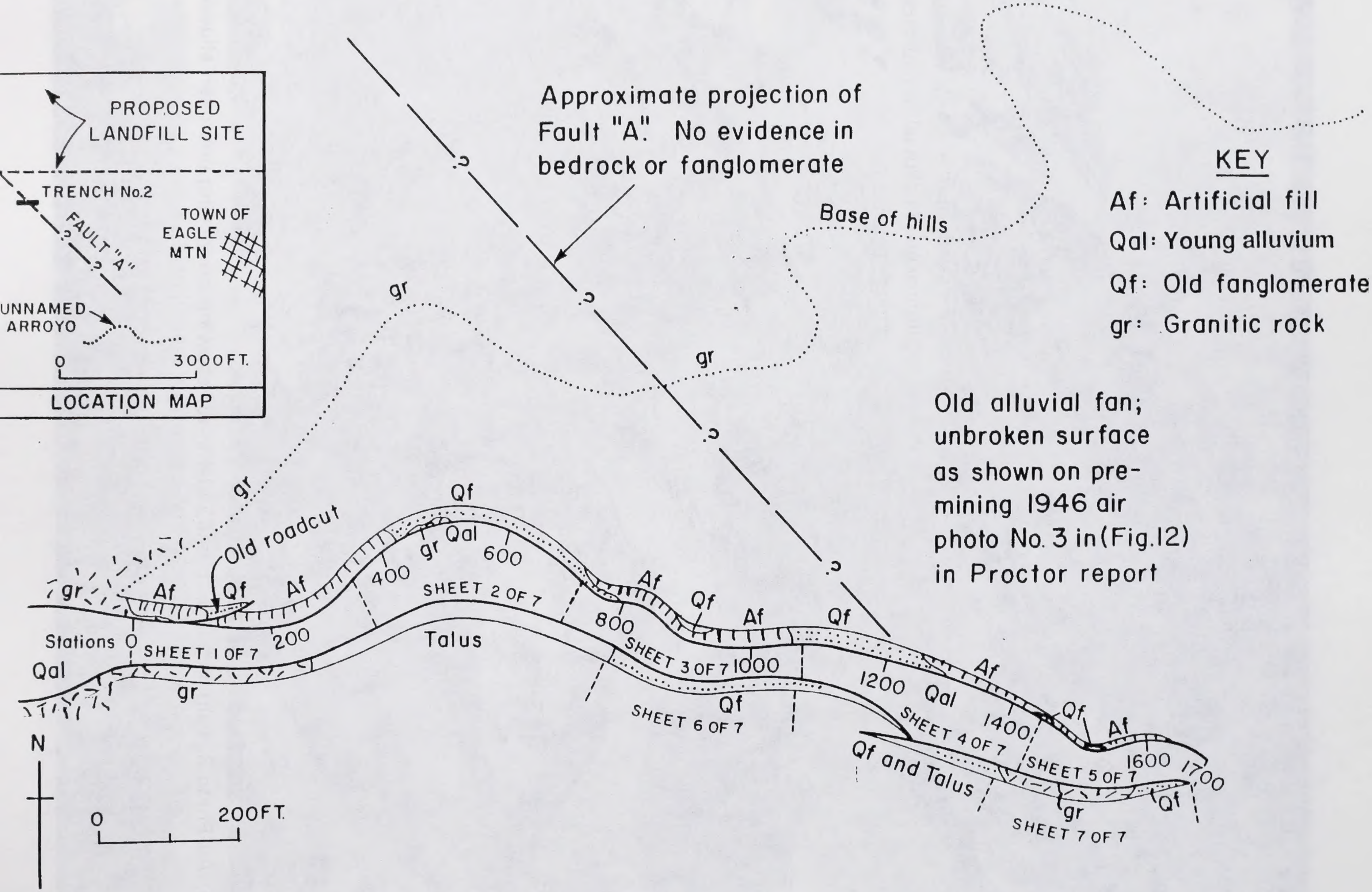


Fig. 12. Air-Photo 3. Fairchild aerial photo, 11-26-46, showing pre-mining unbroken alluvial fan where Fault "A" would cross it (see Plate 1).



GEOLOGIC LOCATION MAP OF UNNAMED ARROYO

3000 FT. SOUTH OF PROPOSED EAGLE MTN. LANDFILL SITE
SEARCH FOR EXTENSION OF FAULT "A"

Figure

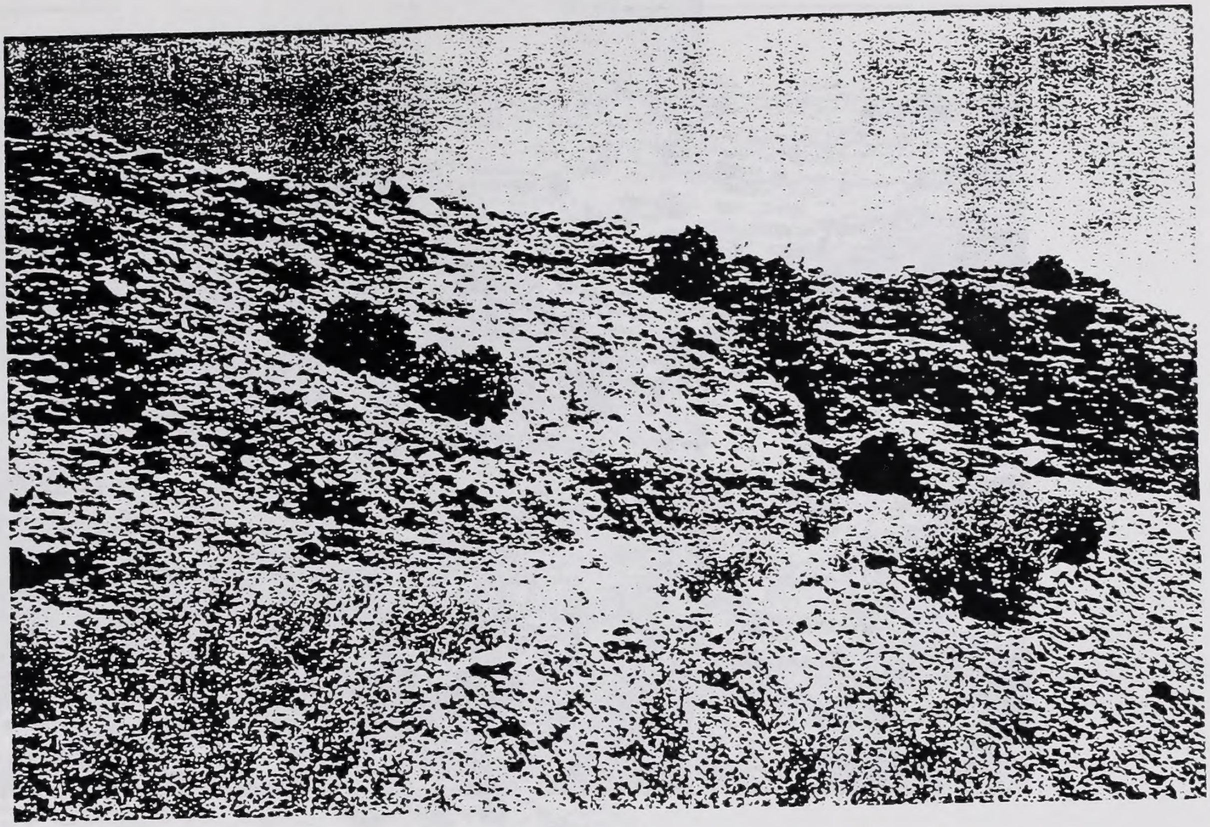


Fig. 14 Photo 1
Station 105, Arroyo N. Wall
(Qf exposure in old road cut.)
Horizontal layers of coarse and
unbroken fine-grained fanglomerate.

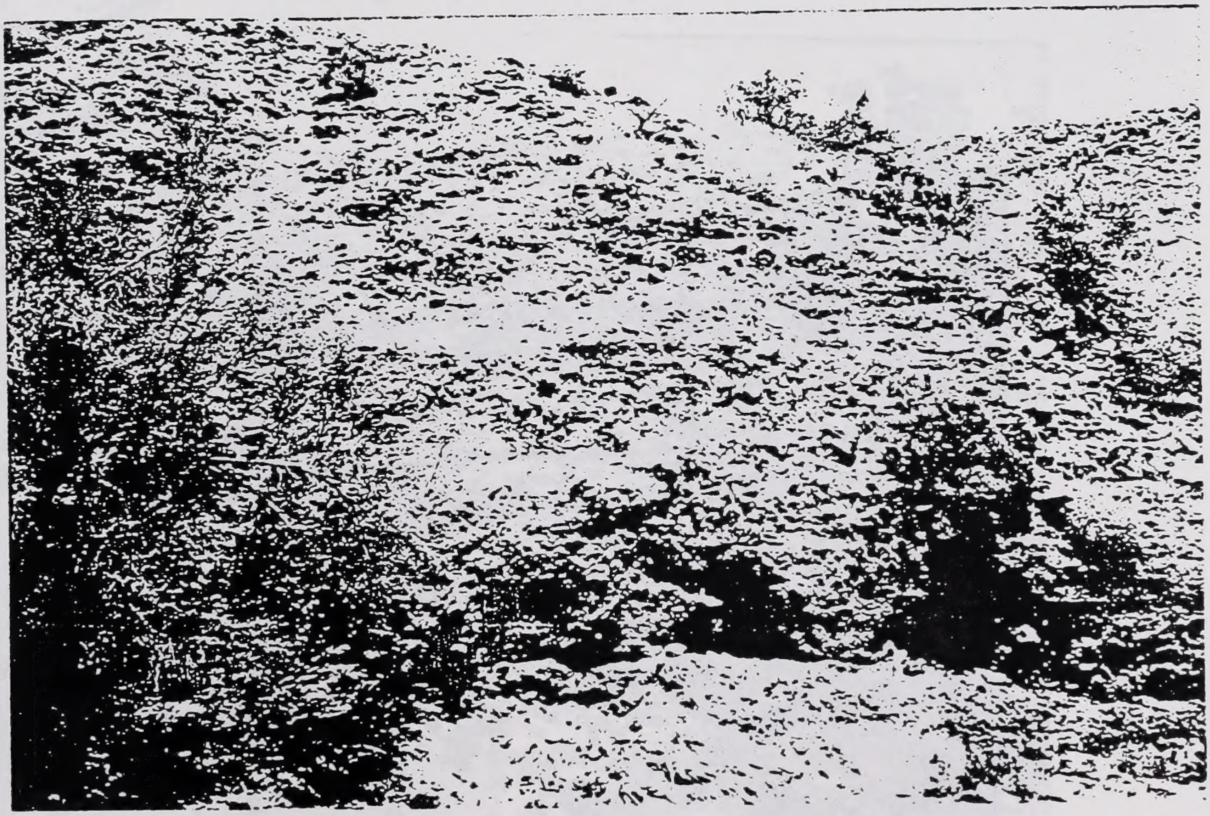


Fig. 15 Photo 2
Station 495, Arroyo N. Wall
20-ft high Qf exposure with many
unbroken horizontal layers of fine-
grained fanglomerate.

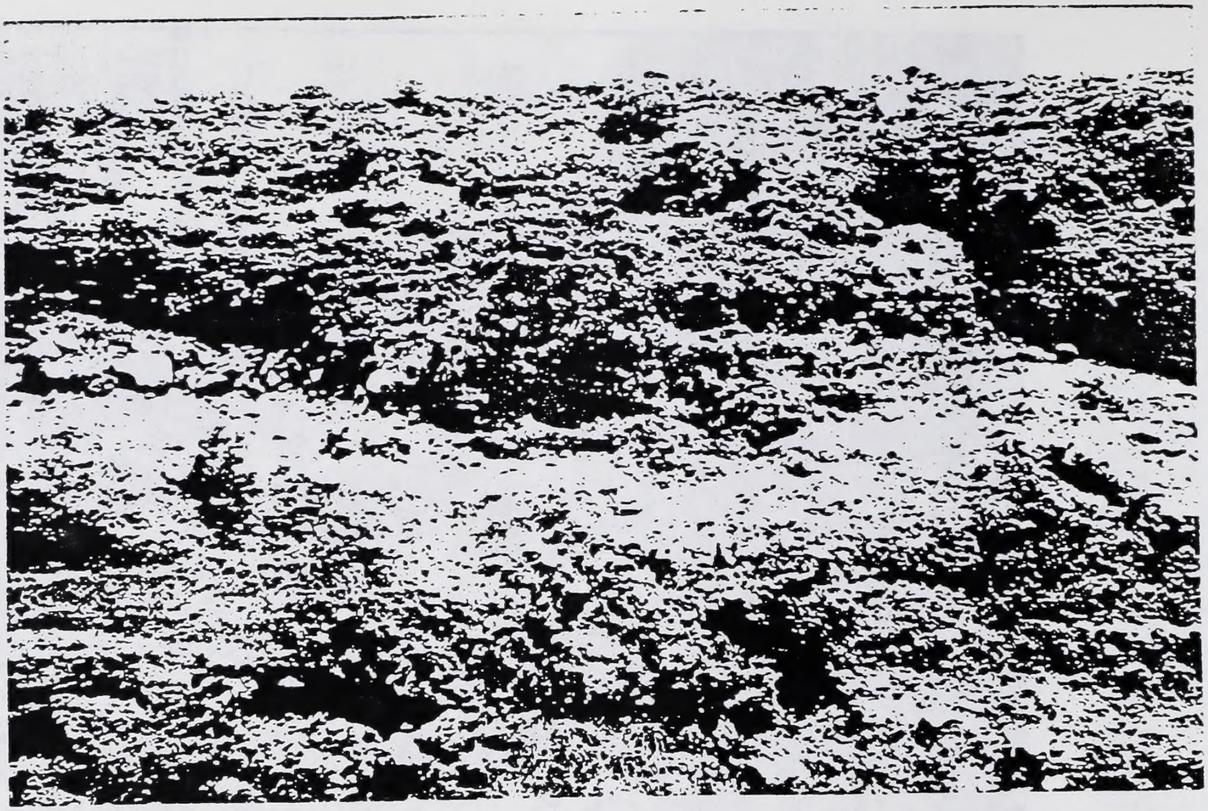


Fig. 16 Photo 3
Station 565, Arroyo N. Wall
20-ft high Qf exposure with many unbroken horizontal fine-grained layers.

Fig. 17 Photo 4
Station 885, Arroyo N. Wall
Unbroken horizontal layers and

Fig. 18 Photo 5
Station 1075. Arroyo N. Wall
Many unbroken horizontal fine-grained layers and lenses.

Fig. 19 Photo 6
Station 1155. Arroyo N. Wall
Many unbroken horizontal fine-grained layers and lenses.

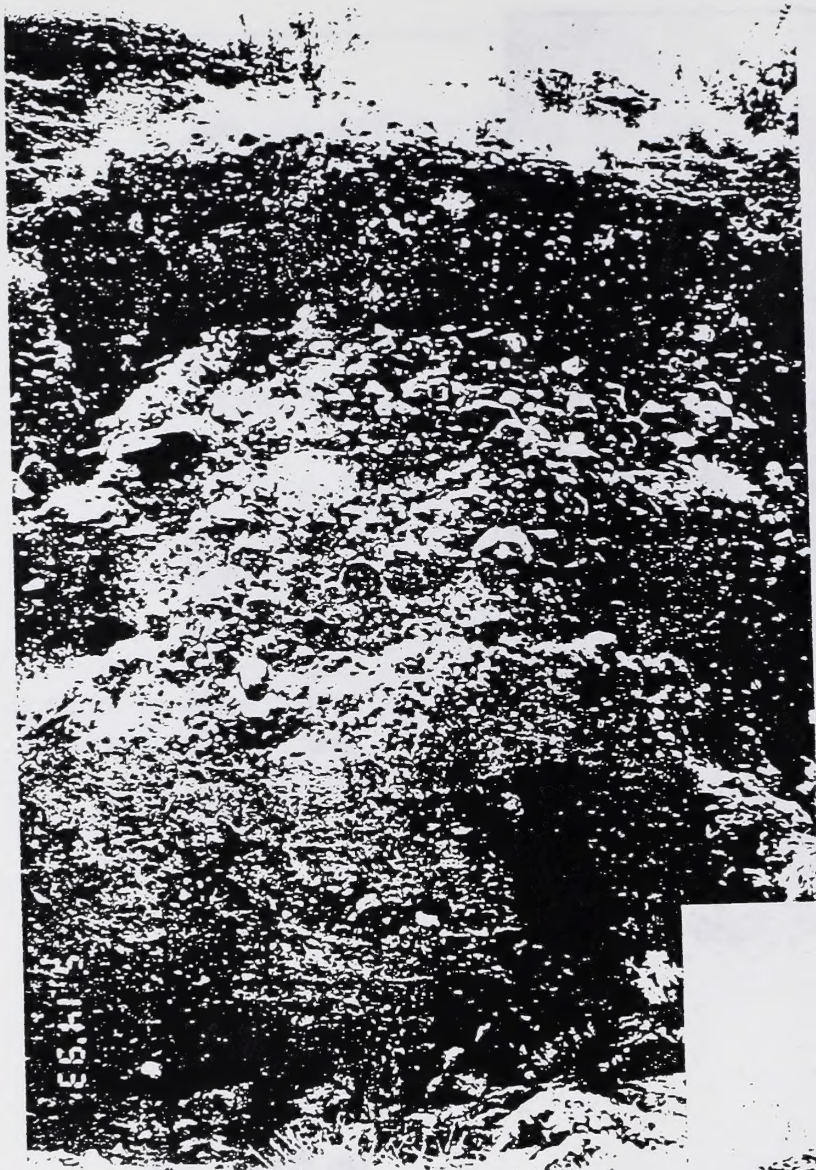


Fig. 20 Photo 7
Station 850. Arroyo S. Wall
Alternating coarse and unbroken fine-grained fanglomerate layers and lenses.

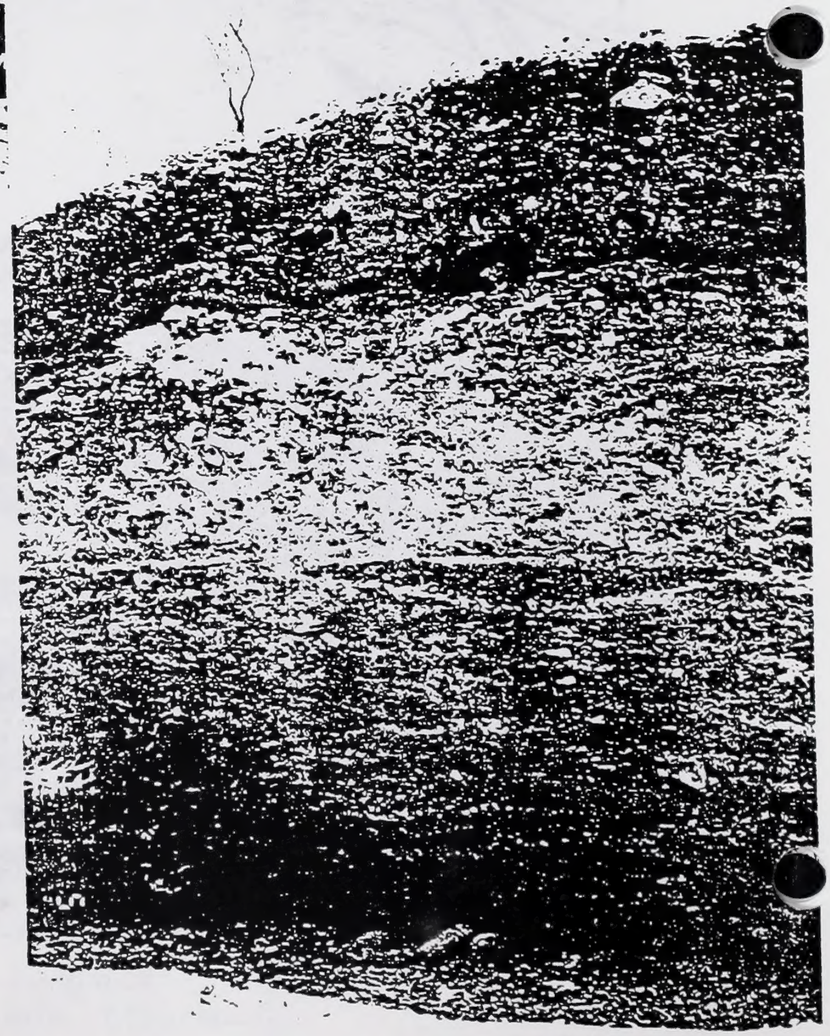
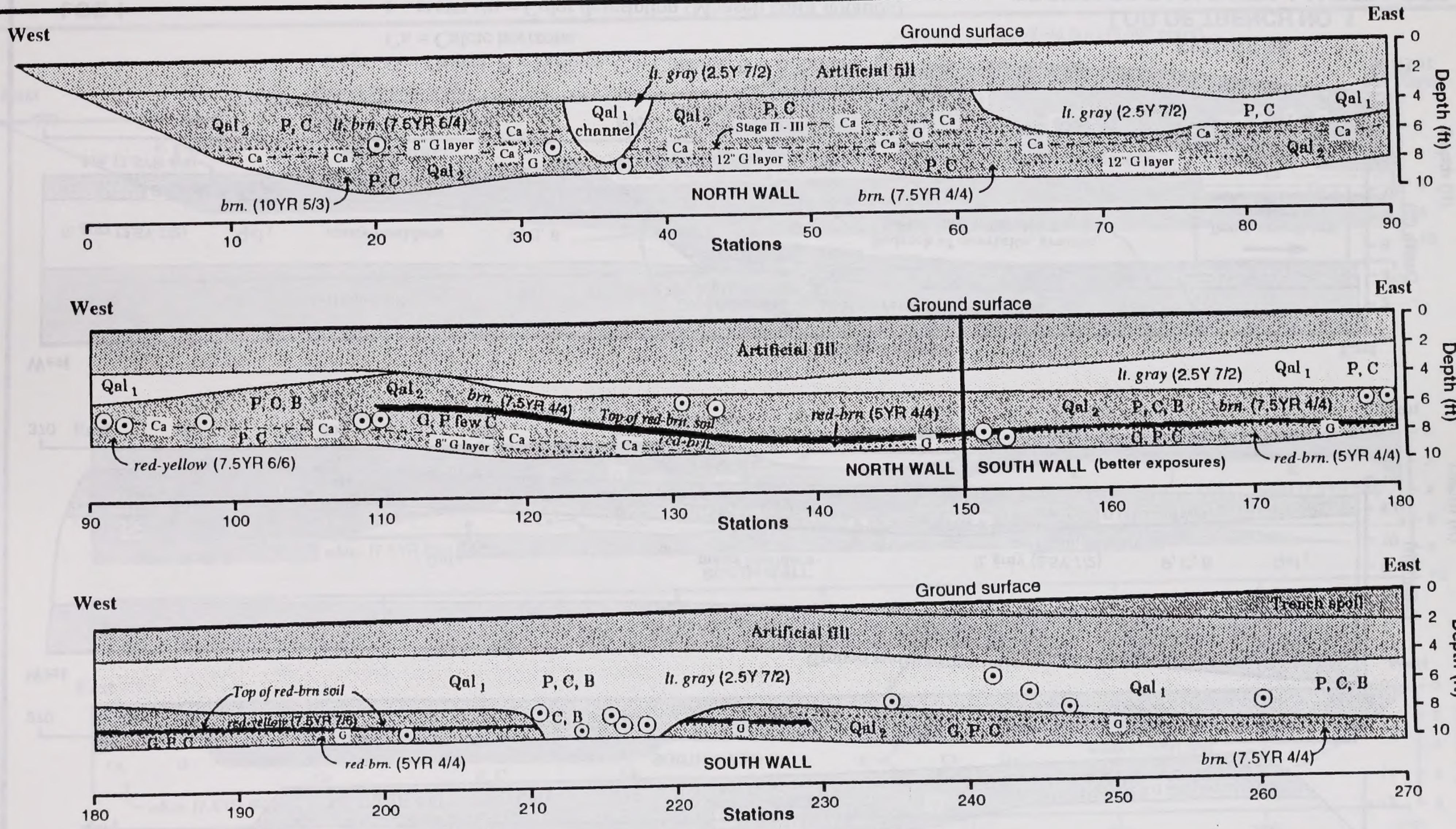


Fig. 21 Photo 8
Station 955. Arroyo S. Wall
Many layers and lenses of unbroken fine-grained fanglomerate.

Fig. 22 Photo 9
Station 1490, Arroyo S. Wall
Granitic rock beneath talus; bedrock fractured but unfaulted.

Fig. 23 Photo 10
Station 1660, Arroyo S. Wall
Talus on layered fanglomerate; fine-grained layers and lenses are unbroken.



Note: Qal$_2$ estimated to be at least 12,000 to 15,000 years old by Dr. Shlemon, based on relative soil profile development (isotope stage 2, argillic {Btj} and calcic horizons). Alluvial stratigraphy unbroken.

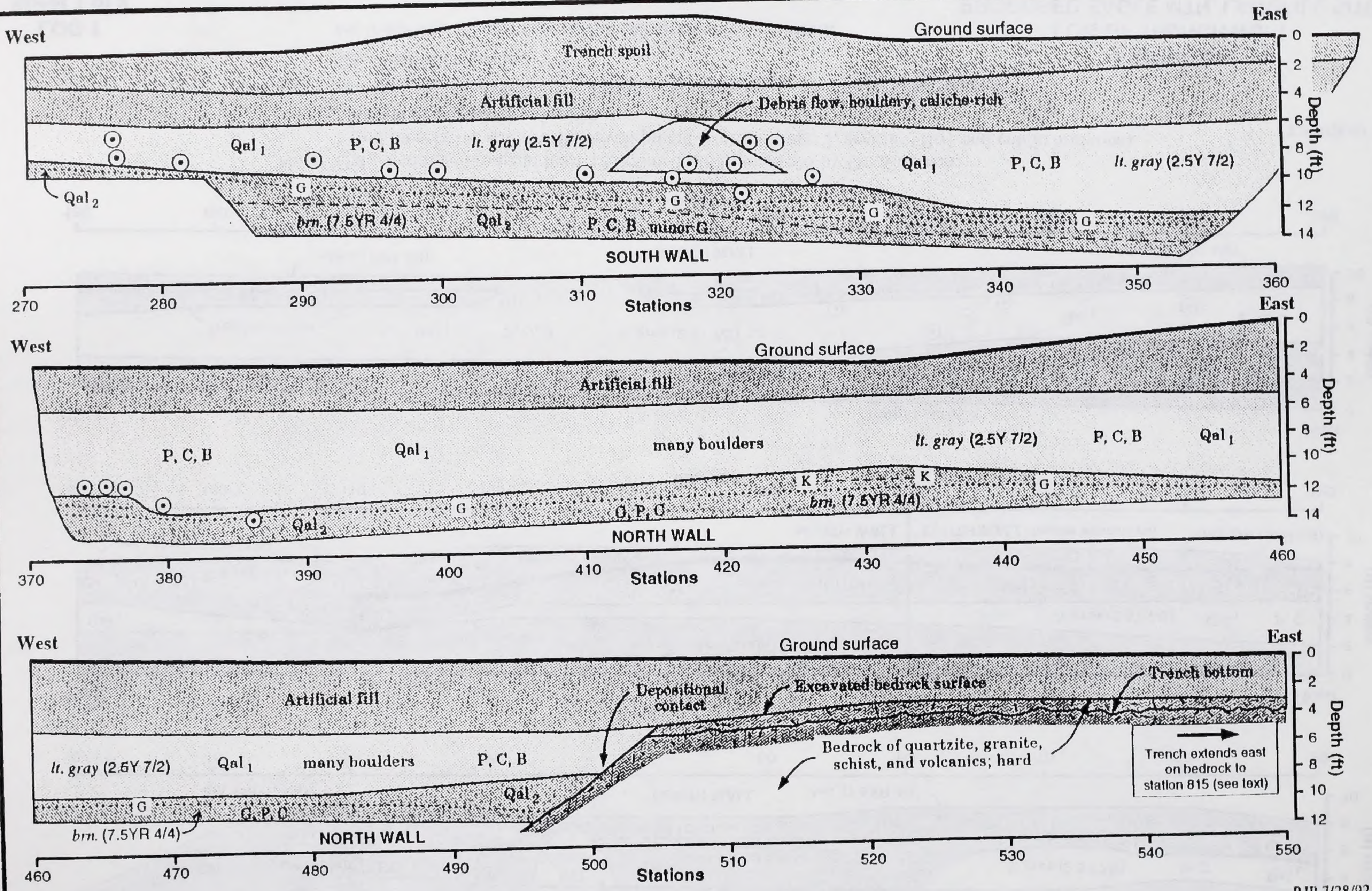
Key: G = Gravel, P = Pebbles, C = Cobbles, B = Boulders, ⊙ = Individual boulder, Ca = Calcic horizons.

brn. (7.5YR 4/4) = Color description (Munsell color notation).

RJP 7/28/92

LOG 1
Sheet 1 of 2

FIGURE 24
LOG OF TRENCH NO. 1
PROPOSED EAGLE MTN. LANDFILL SITE

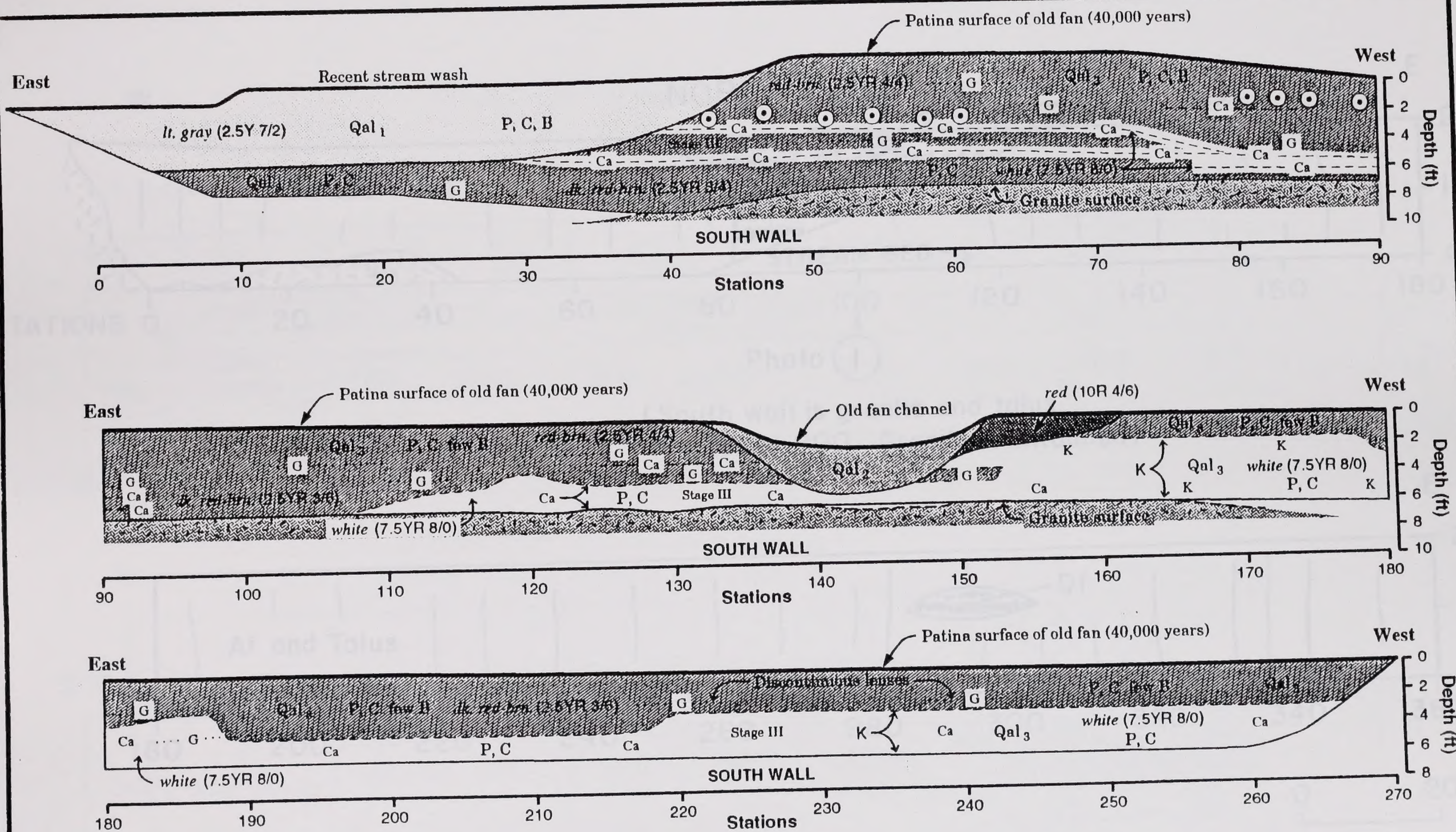


RJP 7/28/92 & 8/5/92

Key: G = Gravel, P = Pebbles, C = Cobbles, B = Boulders, ⊙ = Individual boulder,
Ca = Calcic horizons.
brn. (7.5YR 4/4) = Color description (Munsell color notation).

FIGURE 25
LOG OF TRENCH NO. 1
PROPOSED EAGLE MTN. LANDFILL SITE

LOG 1
Sheet 2 of 2



Note: Qal_3 estimated by Dr. Shlemon to be at least isotope stage 3 or greater than 40,000 years old.
No faults seen in trench.

Key: G = Gravel, P = Pebbles, C = Cobbles, B = Boulders, ⊙ = Individual boulder,
Ca = Calcic horizons, K = Hard caliche.
brn. (7.5YR 4/4) = Color description (Munsell color notation).

RJP 7/28/92

FIGURE 26
LOG OF TRENCH NO. 2
PROPOSED EAGLE MTN. LANDFILL SITE

LOG 2
Sheet 1 of 1

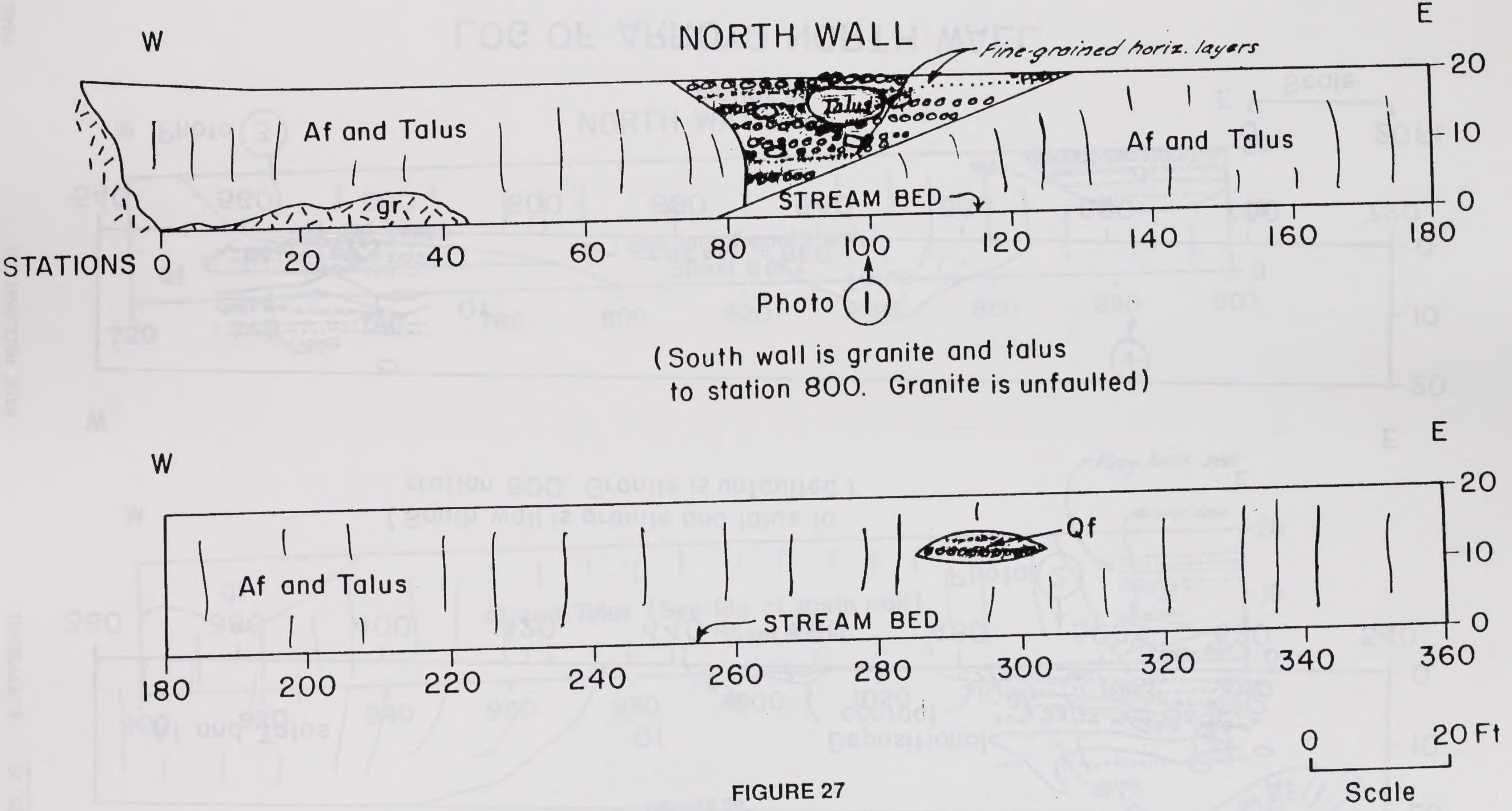


FIGURE 27

LOG OF ARROYO NORTH WALL

3000 FT. SOUTH OF PROPOSED EAGLE MTN. LANDFILL SITE

SEE FIG. 13 FOR LOCATION

Sheet 1 of

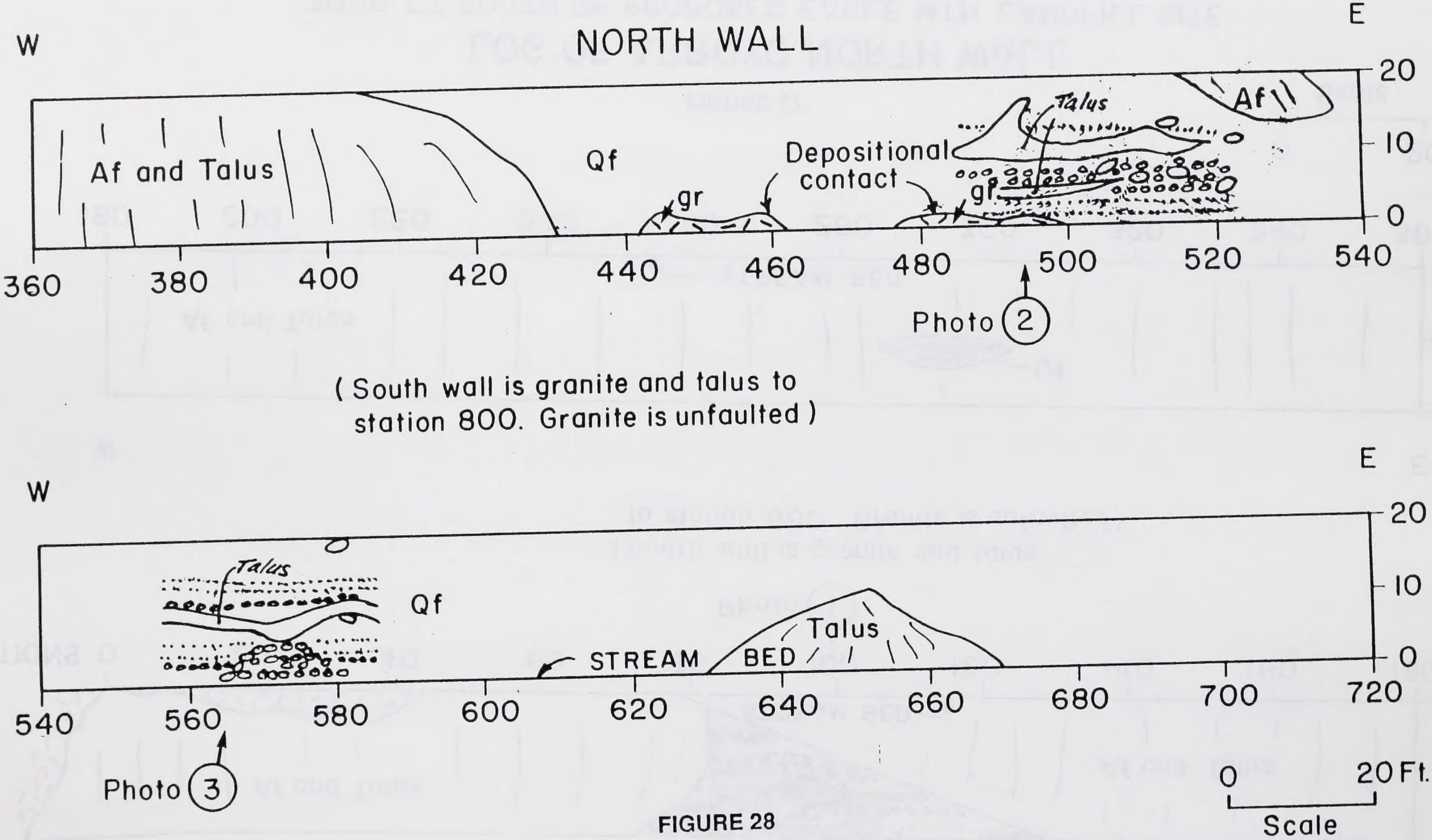
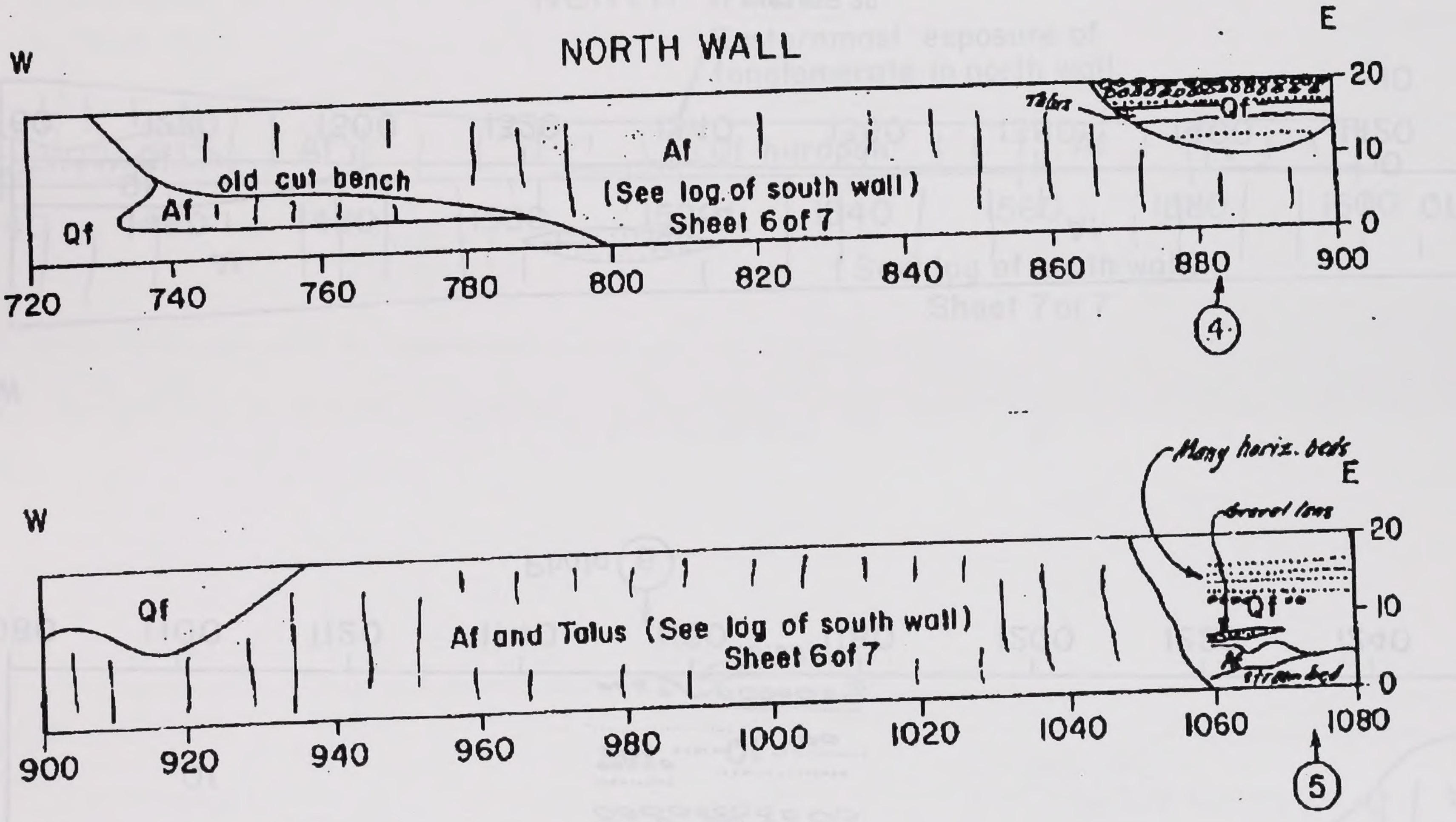


FIGURE 28

LOG OF ARROYO NORTH WALL



0 20Ft.
Scale

Sheet 3 of

FIGURE 29

LOG OF ARROYO NORTH WALL

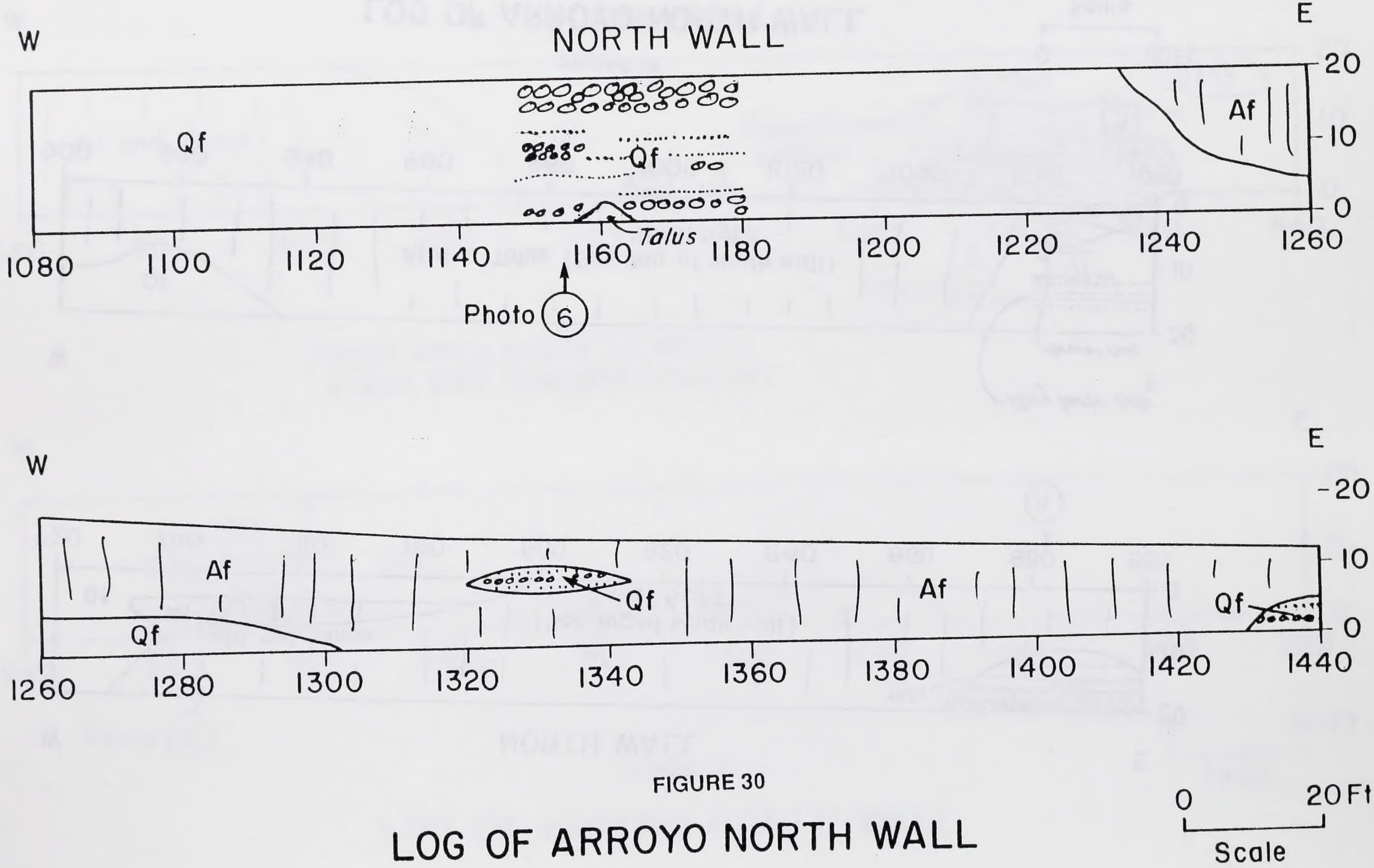


FIGURE 30

LOG OF ARROYO NORTH WALL

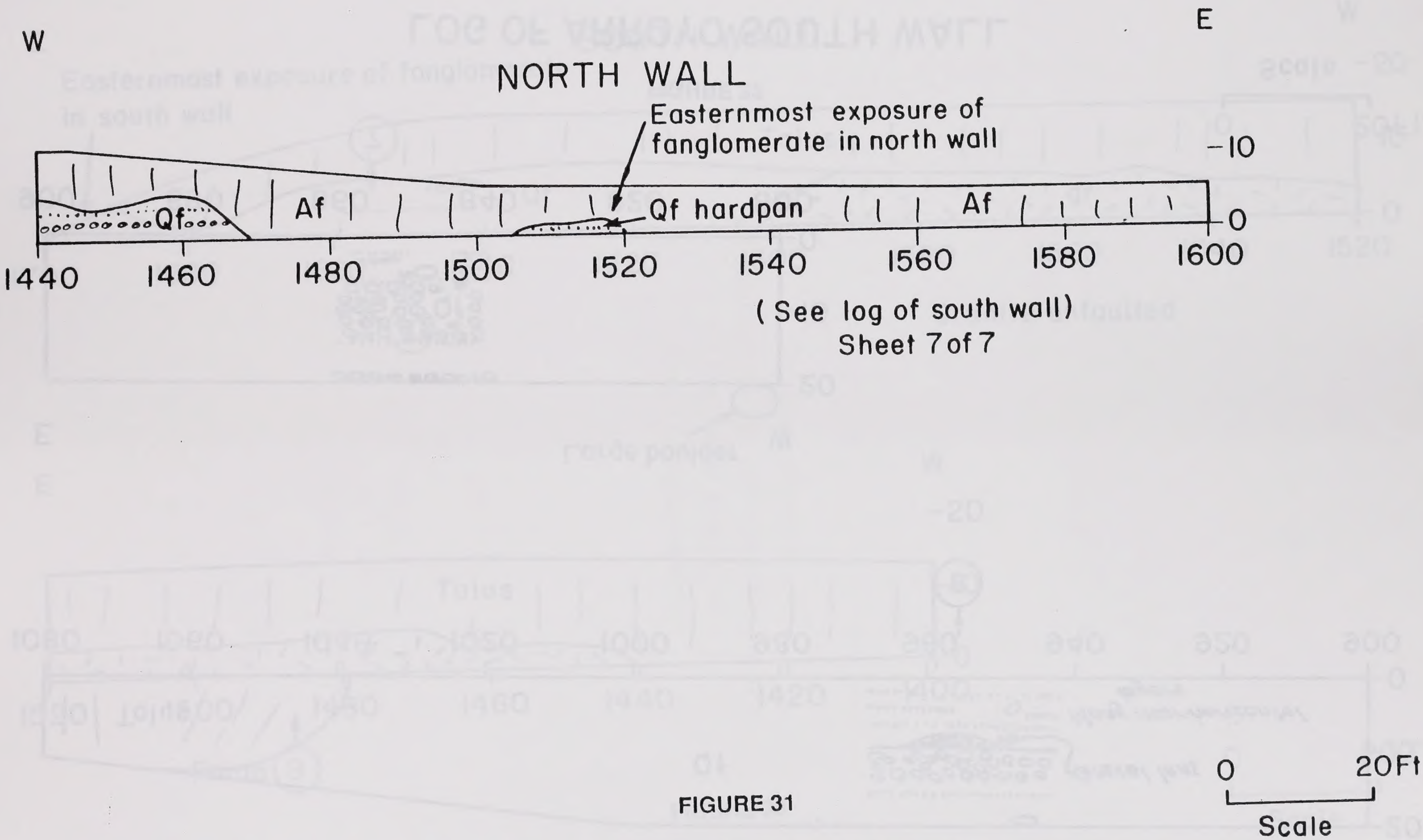


FIGURE 31

LOG OF ARROYO NORTH WALL

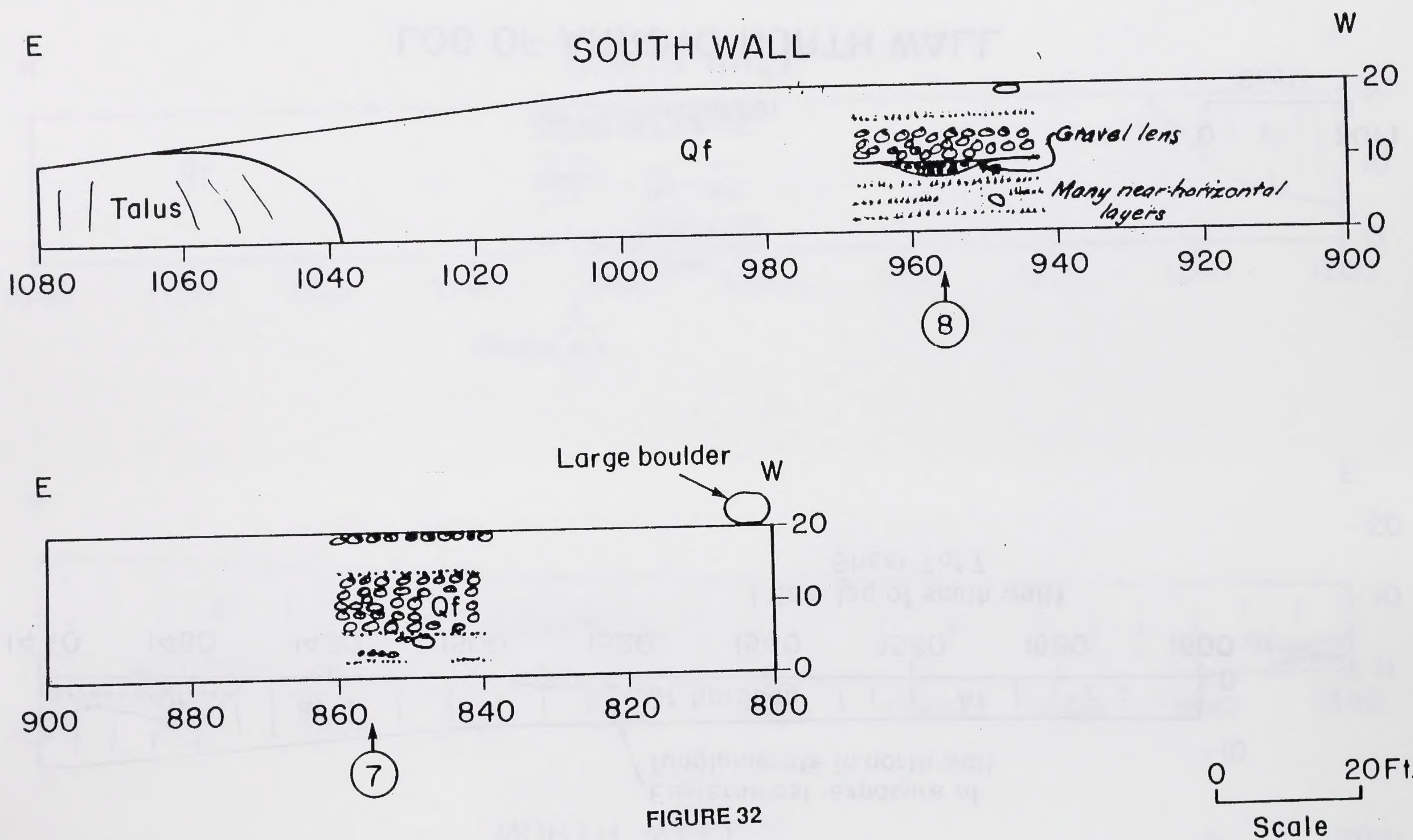


FIGURE 32

LOG OF ARROYO SOUTH WALL

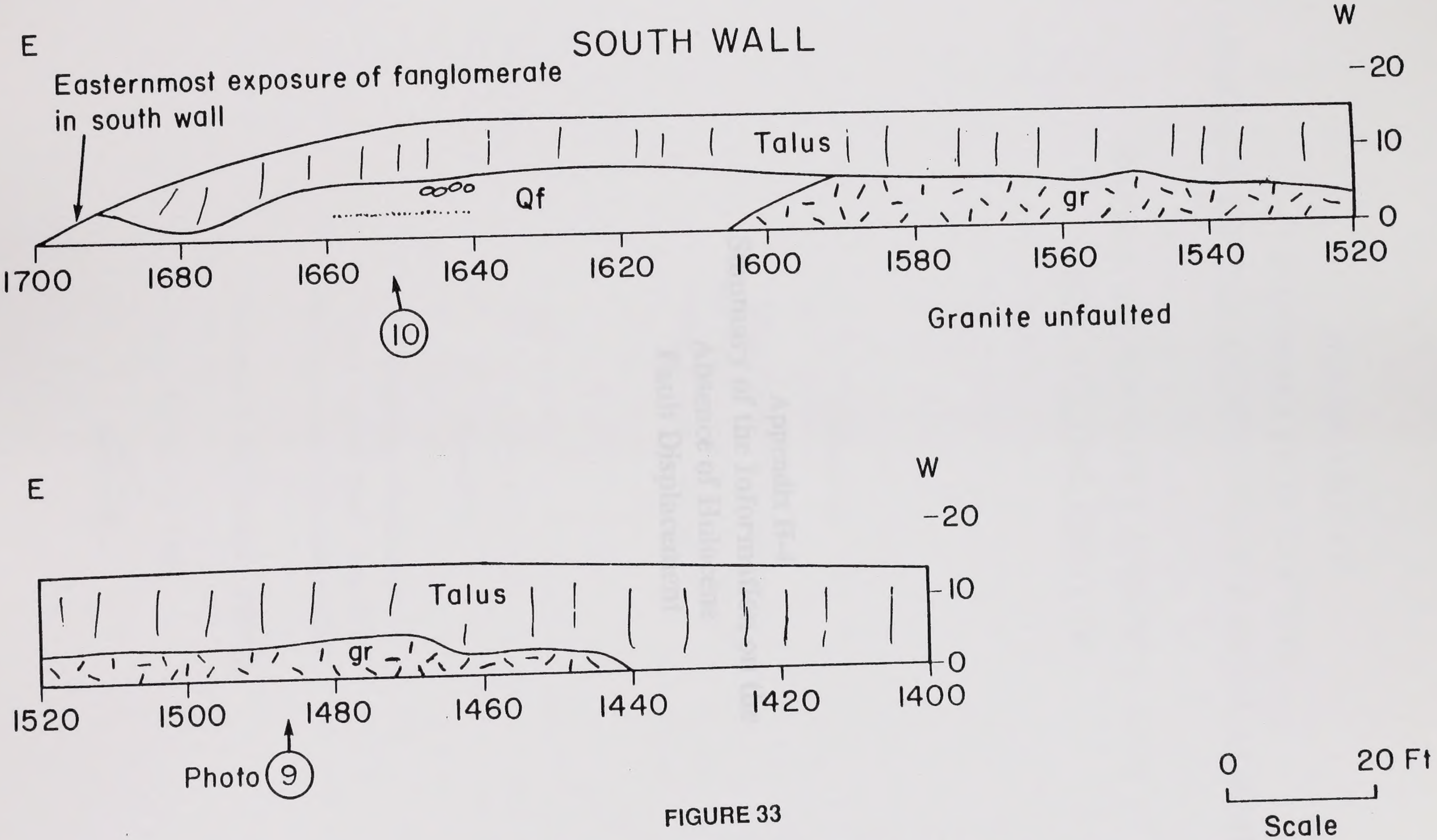


FIGURE 33

LOG OF ARROYO SOUTH WALL

Appendix H-4
Summary of the Information on the Absence of Holocene Fault Displacement

SUMMARY OF INFORMATION ON THE ABSENCE OF HOLOCENE FAULT DISPLACEMENT

EAGLE MOUNTAIN LANDFILL AND RECYCLING CENTER

Prepared for:

Mine Reclamation Corporation
960 Tahquitz Canyon Way, Suite 204
Palm Springs, California 92262

Prepared by:

GeoSyntec Consultants
16541 Gothard Street, Suite 211
Huntington Beach, California 92647

GeoSyntec Project Number: CE4030

4 November 1993

EXECUTIVE SUMMARY

This report summarizes information concerning the age of faulting and the absence of Holocene fault displacement at and near the Mine Reclamation Corporation (MRC) Eagle Mountain Landfill and Recycling Center, located in eastern Riverside County, California. This summary has been prepared at the request of staff from the California Regional Water Quality Control Board, Colorado River Basin Region (RWQCB). The RWQCB is currently reviewing the Report of Waste Discharge (ROWD) for the proposed landfill.

Information on the age of faulting and the absence of Holocene fault displacement at the Eagle Mountain site includes field investigations performed by GSi/water, Inc., Mr. Richard J. Proctor, and Dr. Roy J. Shlemon during preparation of the ROWD and Supplemental Volume Number 1 of the ROWD, information on historical seismicity compiled by Professor Geoffrey R. Martin of the University of Southern California for the ROWD, and information on active and potentially active faults in California, published by the California Department of Conservation, Division of Mines and Geology.

The results of the investigations show that Holocene-age, as well as underlying Pleistocene-age, alluvial sediments are unbroken by faults at the Eagle Mountain site. The lack of Holocene fault displacement at the site is supported by geologic field mapping, trench logging, aerial-photo analysis, geomorphologic and soil stratigraphic age dating, potassium-argon geo-chronologic age dating, patterns of micro-seismicity in the project vicinity, and the observed pattern of Holocene faulting in southern California. Based on the results of the investigations, there are no faults that have undergone Holocene displacement within 200 ft (60 m) of the Eagle Mountain Landfill. Accordingly, the proposed Eagle Mountain Landfill satisfies both state and federal regulations with respect to the siting of municipal solid waste landfills on or adjacent to Holocene faults.

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TABLE OF CONTENTS (continued)

1. INTRODUCTION

1.1 Overview

This report summarizes available information concerning the age of faulting and the absence of Holocene faults in the vicinity of the Mine Reclamation Corporation (MRC) Eagle Mountain Landfill and Recycling Center, located in eastern Riverside County, California. This summary has been prepared at the request of staff from the California Regional Water Quality Control Board, Colorado River Basin Region (RWQCB). The RWQCB is currently reviewing the Report of Waste Discharge (ROWD) for the proposed landfill.

1.2 Applicable Regulations

Applicable regulations on the siting of municipal solid waste landfills near faults are found in Title 23 of the California Code of Regulations and Title 40 of the Code of Federal Regulations. Section 2533.(d) of Chapter 15, Title 23, of the California Code of Regulations requires that a Class III landfill not be sited on a known Holocene fault, defined by CDMG [Hart, 1985] as a fault on which surface displacement has occurred in the Holocene Epoch (the past 11,000 years). Section 258.13 of Title 40 of the Code of Federal Regulations requires that the landfill not be sited within 200 ft (60 m) of a fault on which displacement is known to have occurred in Holocene time.

1.3 Sources of Information

The available information on faults and the age of faulting at the Eagle Mountain site includes:

- field investigations performed by GSi/water, Inc., Mr. Richard J. Proctor, and Dr. Roy J. Shlemon during preparation of the ROWD; the ROWD was submitted to the RWQCB in December 1992;

- supplemental field investigations performed by GSi/water and Proctor during preparation of Supplemental Volume Number 1 of the ROWD (ROWD-SV1); the ROWD-SV1 was submitted to the RWQCB in June 1993; the supplemental field investigations were performed in response to questions and comments on the ROWD from the RWQCB, the State Water Resources Control Board (SWRCB), and the California Integrated Waste Management Board (CIWMB); the ROWD-SV1 also included (in Appendix O) videotape documentation of the original field investigations performed by Shlemon;

- information on historical seismicity in southern California compiled by Professor Geoffrey R. Martin of the University of Southern California for the ROWD; and

- information on active and potentially active faults in California compiled by the California Department of Conservation, Division of Mines and Geology (CDMG) [Jennings, 1992].

This summary report was prepared by Mr. David B. Dunbar, R.G., and Drs. Rudolph Bonaparte, P.E., and Edward Kavazanjian, P.E., G.E., using the information cited above. The report was reviewed by Dr. Joe Birman of GSi/water, Inc. and Dr. Roy J. Shlemon.

2. GEOLOGIC SETTING

2.1 Regional and Site Geology

The Eagle Mountain Landfill site lies at the eastern extremity of the Southeast Transverse Ranges physiographic province. Bedrock in the project area is composed primarily of meta-sedimentary rocks of Precambrian to Paleozoic age, with intrusions of younger igneous rocks as irregular bodies, dikes, and sills. Structurally, the meta-sedimentary rocks at the project site lie on the northern limb of a northwest-trending anticline. The dips of the meta-sedimentary rock units near the project site are typically between 30 and 60 degrees.

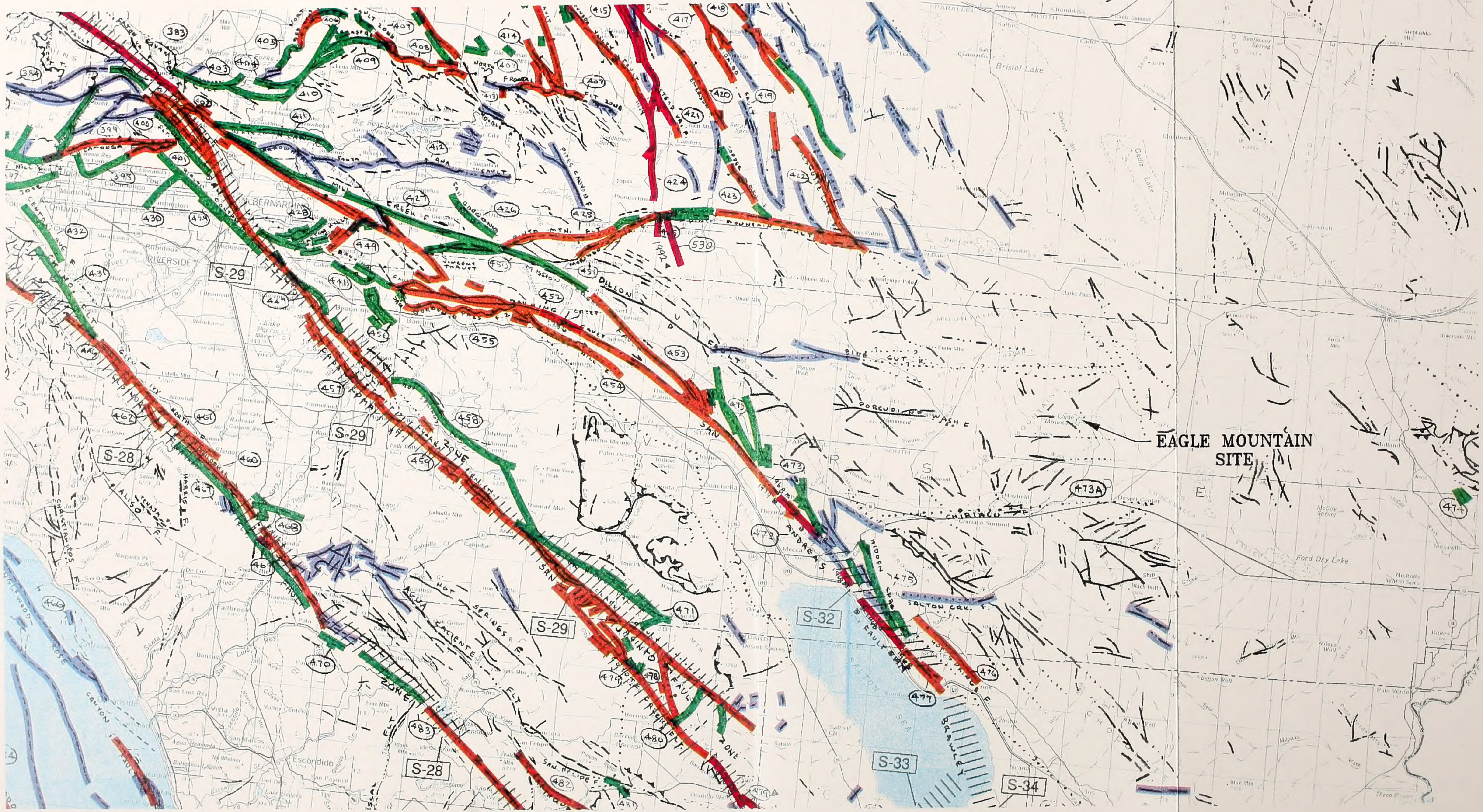
Information on active, potentially active, and inactive faults in the project vicinity, as compiled by CDMG [Jennings, 1992], is shown in Figures 1a and 1b of this report (originally presented as Figures 5.9a and 5-9b in the ROWD). Active faults are defined as those that have undergone displacement during the Holocene Epoch, approximately the past 11,000 years. Potentially active faults are defined as those that have undergone displacement during the Quaternary Period, approximately the past 1,600,000 years, but not in the past 11,000 years. Inactive faults are those that have not moved in at least 1,600,000 years. Figures 1a and 1b indicate that the project site is beyond the eastern limit of Quaternary fault activity in the Southeast Transverse Ranges physiographic province. The same conclusion may be drawn from Figure 2 taken from Martin [1992] (originally presented as Figure 5-10 in the ROWD), which is a plot of earthquakes of magnitude 4.0 or greater recorded in the vicinity of the site since 1932. This figure also shows the project site to be east of the areas of significant seismic activity in southern California.

There are generally two sets of faults at and near the project site; these fault sets trend east-west and northwest-southeast, respectively. The east-west trending faults

that bound the site on the north and south are shown in Figure 1 as well as in Figure 3, Regional Geology (originally presented as Figure 5-5 in the ROWD). These east-west trending faults are categorized by CDMG as inactive [Jennings, 1992]. These faults, which include the Blue Cut, Substation, and the Victory Pass faults, neither transect the site nor pass within 3 miles (5 km) of the site.

Several of the northwest-southeast trending faults do transect the project site. Figure 4 (originally presented as Figure 14-1 in the ROWD-SV1) shows the mapped traces of northwest-southeast trending faults with respect to the proposed footprint of the landfill. The most prominent of these fault traces are labelled Fault A, the Bald Eagle Canyon fault, and the East Pit fault. The CDMG fault activity map (Figure 1) shows one northwest-southeast trending fault in the general vicinity of the landfill (possibly the Bald Eagle Canyon fault). The family of northwest-southeast trending sub-parallel faults shown in Figure 4 are not prominent enough to be identified on the CDMG map. These relatively small faults were only identified by the detailed investigation performed at the site for previous mining operations and for the proposed landfill development.

The aforementioned northwest-southeast trending faults transect the landfill footprint. Only these faults are a factor with respect to the potential for active faulting within or adjacent to the footprint of the proposed landfill. Other geologic features relevant to the fault investigations described in this report include two northeasterly-trending intrusive quartz latite dikes that transect the faults, a significant erosional lineament that projects across the northeast corner of the landfill footprint, and undisturbed Quaternary alluvial deposits that exist at the range front of the Eagle Mountains. The dikes and erosional lineament are shown on Figure 4. The northernmost of the two dikes is labelled Dike 1 and the other dike is labelled Dike 2. The erosional lineament is labelled Lineament B.



SCALE 1:750,000

(1 INCH EQUALS APPROXIMATELY 12 MILES)

10 0 10 20 30 40 50 Miles

10 0 10 20 30 40 50 60 Kilometers

SOURCE: "PRELIMINARY FAULT ACTIVITY MAP OF CALIFORNIA", CDMG, [1992].

SEE FIGURE NO. 1B FOR LEGEND

EAGLE MOUNTAIN

LANDFILL AND RECYCLING CENTER

RIVERSIDE COUNTY, CALIFORNIA

PREPARED FOR:

MINE RECLAMATION CORPORATION

GEOSYNTEC CONSULTANTS

HUNTINGTON BEACH, CALIFORNIA

FAULT MAP

PROJECT NO.:	CE4030-02
DOCUMENT NO.:	MRC-065
FIGURE NO.:	1a

4030E068 199212021055

Geologic Time Scale			Years Before Present (Approx.)	Fault Symbol	Recency of Movement	DESCRIPTION: ON LAND	DESCRIPTION: OFFSHORE
Quaternary	Late Quaternary	Historic	200			Displacement during historic time (e.g. San Andreas fault 1906). Includes areas of known fault creep.	
		Holocene	10,000			Displacement during Holocene time.	Fault offsets seafloor sediments or strata of Holocene age.
		Pleistocene	700,000			Faults showing evidence of displacement during late Quaternary time. / Mesozoic Foothills fault system along which short segments of late Cenozoic faulting has taken place.	Fault cuts strata of late Pleistocene or older Quaternary age.
	Early Quaternary		1,600,000			Undivided Quaternary faults – most faults in this category show evidence of displacement during the last 1,600,000 years; possible exceptions are faults which displace rocks of undifferentiated Plio-Pleistocene age.	
Pre-Quaternary			4.5 billion (Age of earth)			Faults without recognized Quaternary displacement or showing evidence of no displacement during Quaternary time. Not necessarily inactive.	Fault cuts strata of Pliocene or older age.

ADDITIONAL FAULT SYMBOLS

U = Upthrown side (relative or apparent)
D = Downthrown side (relative or apparent)

Bar and ball on downthrown side (used where space is limited)

Arrows along fault indicate relative or apparent direction of lateral movement.

Arrow on fault indicates direction of dip

Low angle fault (barbs on upper plate). Fault surface generally dips less that 45° but locally may have been subsequently steepened. On offshore faults, barbs simply indicate a reverse fault regardless of steepness of dip.

OTHER SYMBOLS

204 Numbers refer to annotations listed in the Appendices of the accompanying report. Annotations include fault name, age of fault movement, and pertinent references including Special Studies Zone maps where a fault has been zoned by the Alquist-Priolo Special Studies Zone Act of 1972 (amended 1974 and 1975). This Act requires the State Geologist to delineate zones to encompass all potentially and recently active faults.

Fault segment associated with a significant linear trend of accurately located earthquake epicenters (magnitude 0.2 or greater). Generally aligned along strike slip faults having Quaternary displacement, but not necessarily with historic surface rupture. Lack of seismic activity along any fault is no indication that the fault may not be active in the future (e.g. San Andreas fault north of San Francisco). Epicenter data are derived from closely spaced seismic stations and include either continuing microseismicity or aftershocks associated with relatively large earthquakes.

S-8 Aligned seismicity on fault segments are referenced in Appendices D and E.

SOURCE: "PRELIMINARY FAULT ACTIVITY MAP OF CALIFORNIA", CDMG, [1992].

SEE FIGURE No. 1a FOR MAP

EAGLE MOUNTAIN
LANDFILL AND RECYCLING CENTER
RIVERSIDE COUNTY, CALIFORNIA
PREPARED FOR:
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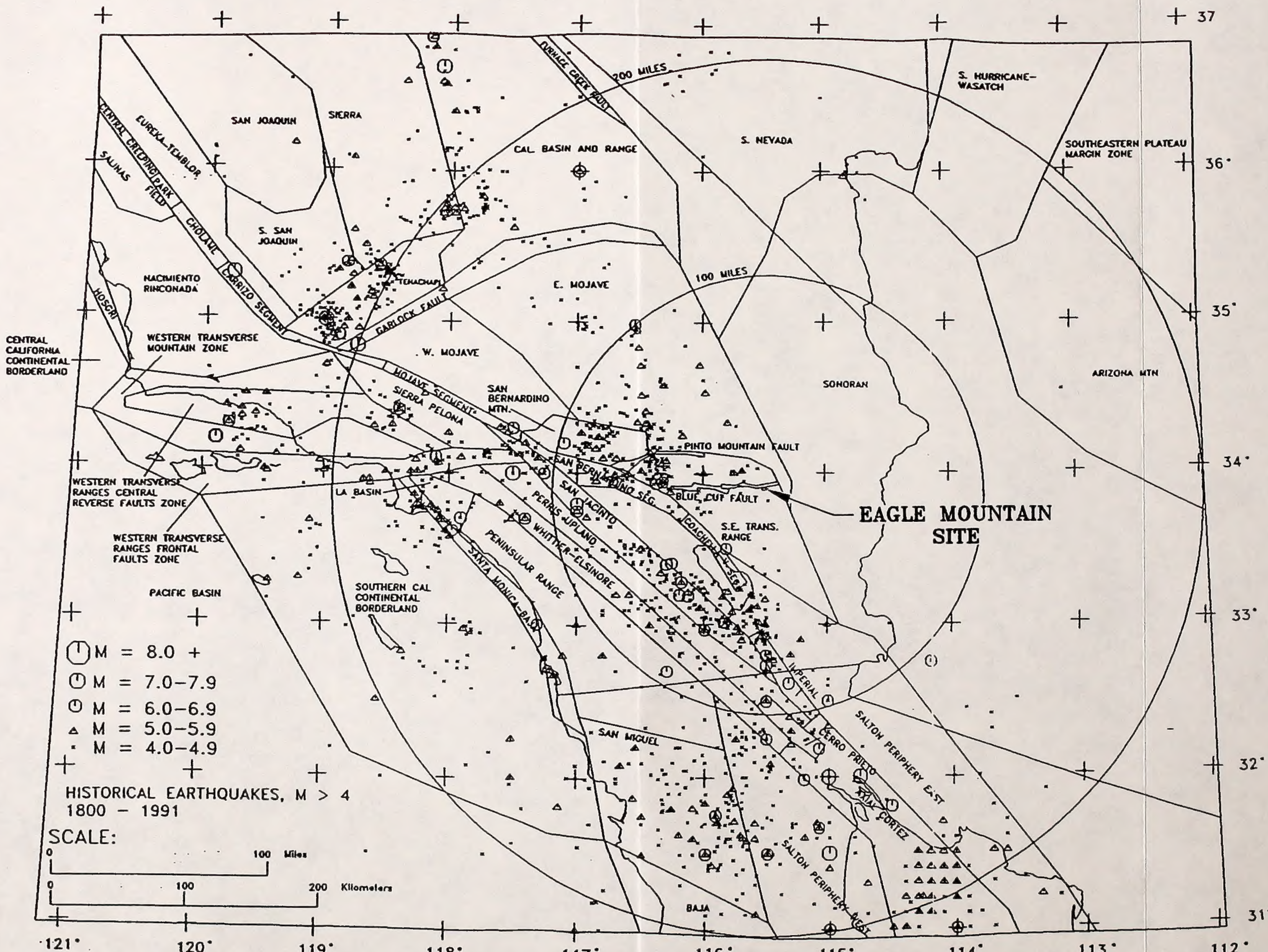
FAULT MAP LEGEND

GEOSYNTEC CONSULTANTS
HUNTINGTON BEACH, CALIFORNIA

PROJECT NO.:	CE4030-02
DOCUMENT NO.:	MRC-065
FIGURE NO.:	1b

4030E069 199212031000



EAGLE MOUNTAIN

LANDFILL AND RECYCLING CENTER
RIVERSIDE COUNTY, CALIFORNIA
PREPARED FOR:
MINE RECLAMATION CORPORATION

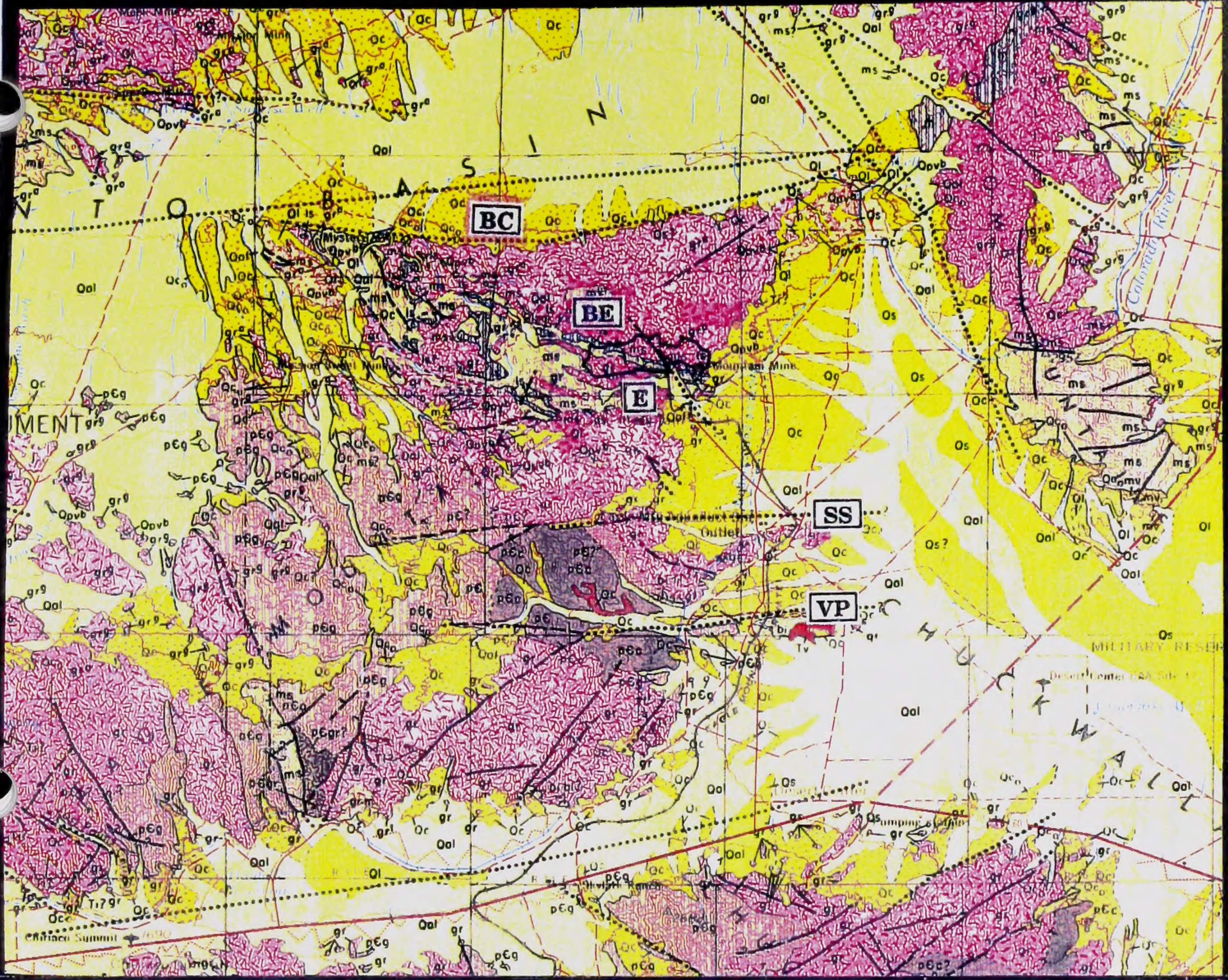
SOUTHERN CALIFORNIA SEISMIC ZONES AND HISTORICAL SEISMICITY

GEOSYNTEC CONSULTANTS
HUNTINGTON BEACH, CALIFORNIA

FIGURE NO.	2
PROJECT NO.	CE4030-02
DATE:	MAY-13-96

SOURCE: GeoSyntec (1992), REPORT OF WASTE DISCHARGE, EAGLE MOUNTAIN LANDFILL AND RECYCLING CENTER, APPENDIX D, MARTIN (1992)

DWG: 3586F001 199605131709 AB



Explanation

SEDIMENTARY AND METASEDIMENTARY ROCKS

- Qs — Dune sand
- Qal — Alluvium
- Ql — Quaternary lake deposits
- Qc — Pleistocene nonmarine
- Pre-Cretaceous metamorphic rocks
- ms — Pre-Cretaceous metasedimentary rocks
- pЄ — Undivided Precambrian metamorphic rocks

IGNEOUS AND META-IGNEOUS ROCKS

- Qpv — Pleistocene volcanic rocks
- Tertiary intrusive rocks
- Tertiary volcanic rocks
- gr — Mesozoic granitic rocks
- pЄc — Precambrian igneous and metamorphic rock complex
- pЄg — Undivided Precambrian granitic rocks

- BC — Blue Cut fault
- BE — Bald Eagle Canyon fault
- SS — Substation fault
- VP — Victory Pass fault
- Fault: solid where known, dashed where inferred, dotted where concealed
- E — Proposed landfill site

Source: C.D.M.G. Geologic Map of California Salton Sea Sheet, 1967

N

0 5 miles

Scale

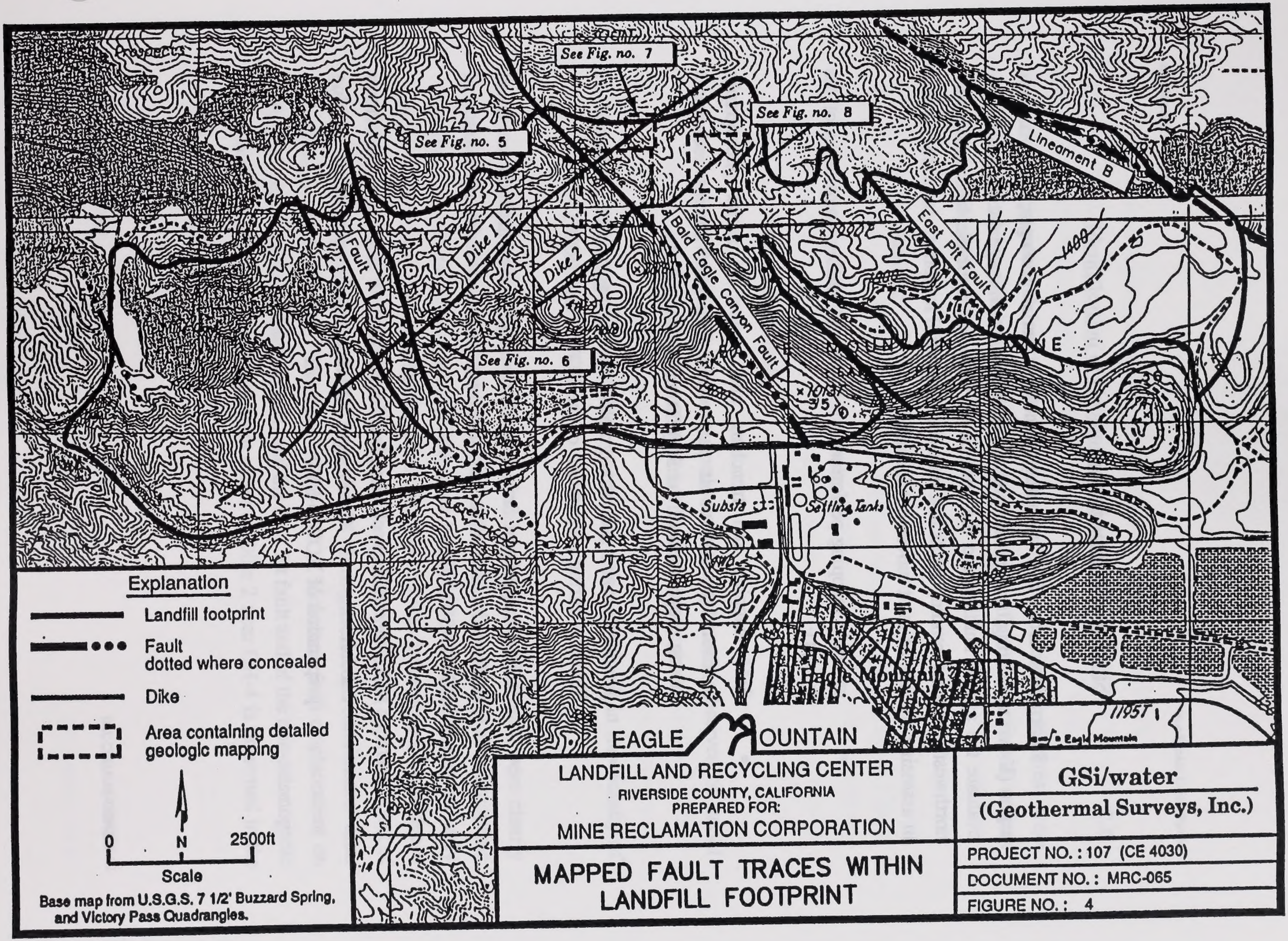
EAGLE MOUNTAIN

LANDFILL AND RECYCLING CENTER
RIVERSIDE COUNTY, CALIFORNIA
PREPARED FOR:
MINE RECLAMATION CORPORATION

REGIONAL GEOLOGY

GSi/water
(Geothermal Surveys, Inc.)

PROJECT NO. : 107 (CE 4030)
DOCUMENT NO. : MRC-065
FIGURE NO. : 3



EAGLE MOUNTAIN

LANDFILL AND RECYCLING CENTER
RIVERSIDE COUNTY, CALIFORNIA
PREPARED FOR:
MINE RECLAMATION CORPORATION

MAPPED FAULT TRACES WITHIN LANDFILL FOOTPRINT

GSi/water
(Geothermal Surveys, Inc.)

PROJECT NO. : 107 (CE 4030)
DOCUMENT NO. : MRC-065
FIGURE NO. : 4

2.2 Site Specific Information

Information from field mapping, trenching, aerial photographs, potassium-argon (K-Ar) age dating, and geomorphic and soil stratigraphic age dating was used to evaluate the age of faulting and the absence of Holocene fault displacement on the northwest-southeast trending faults that transect the landfill footprint. Information used in assessing the age of fault movement includes:

- geologic mapping performed by GSi/water during preparation of the ROWD;
- field mapping and trenching and review of aerial photographs conducted by Proctor as part of the geological studies undertaken during preparation of the ROWD and ROWD-SV1;
- geomorphic and soil stratigraphic age dating studies performed by Shlemon during preparation of the ROWD and ROWD-SV1;
- detailed mapping of fault-dike relationships and of areas of suspected faulting and fault offset performed by GSi/water during preparation of ROWD-SV1; and
- K-Ar age dating of samples from Dikes 1 and 2 by Geochron Laboratories of Cambridge, Massachusetts performed during preparation of ROWD-SV1.

2.3 Identification of Geomorphic Features

Five prominent northwest-southeast trending geomorphic features were identified as requiring evaluation for evidence of Holocene fault displacement, or lack thereof, at the project site:

- Fault A;
- the Bald Eagle Canyon fault;
- the East Pit fault;
- Lineament B, a strong northwest-trending feature observed on aerial photographs and during aerial reconnaissance; and
- an apparent northwesterly trending offset of Dike 2 in the vicinity of corehole CH-4.

Fault A, the Bald Eagle Canyon fault, and the East Pit fault were clearly identified in the field mapping performed for preparation of the ROWD as seismogenic features. Lineament B was initially identified by CDMG personnel during an early aerial reconnaissance for preparation of the ROWD and was investigated for evidence of faulting owing to its generally northwest-southeast alignment. The apparent offset of Dike 2 was identified by RWQCB personnel during aerial reconnaissance after submission of the ROWD. Evidence of the lack of Holocene fault displacement on Fault A, the Bald Eagle Canyon fault, and the East Pit fault and of the non-seismogenic origin of Lineament B and the apparent offset of Dike 2 near CH-4 is presented in the next section of this summary report.

In addition to the five geomorphic features discussed above, segments of two other northwest-southeast trending faults mapped in bedrock at the project site are shown in Figure 4. The lack of sediment cover prevents soil stratigraphic age dating of these features. Additionally, the absence of dike crossings prevent an evaluation based upon the age of the dikes. However, the parallel, "en echelon" structure of the northwest-southeast trending fault system indicates that all of the northwest-southeast faults at the site formed at about the same time and under the same tectonic stress regime. Therefore, it is concluded that the two additional faults segments within the landfill footprint are of the same geologic age as Fault A, the Bald Eagle Canyon fault, and the East Pit fault. Based on the information presented subsequently in this report, it can also be concluded that these additional fault segments are pre-Holocene in age.

3. EVALUATION OF FEATURES

3.1 Introduction

This section of the report present a summary of the results and conclusions from the sources of information cited previously in Section 2.2. The previously-cited information is contained in the ROWD and ROWD-SV1, and in the fault activity map from CDMG. In particular, it is noted that Appendix O of the ROWD-SV1 contains videotape documentation of the investigations performed by Shlemon [1993] for the Bald Eagle Canyon fault, Fault A, and the East Pit fault.

3.2 Bald Eagle Canyon Fault

Evidence that displacement has not occurred on the Bald Eagle Canyon fault in over 11,000 years includes observations of unbroken alluvium from pre-mining aerial photographs, field trenching, and exposures of the fault trace in the East Pit wall. This evidence is summarized as follows:

- unbroken pre-Holocene alluvium in Trench 1 above the projection of the Bald Eagle Canyon fault, dated as at least 12,000 to 15,000 years old and possibly up to 40,000 to 100,000 years old, shows no evidence of fault offset [Shlemon, 1993; Proctor, 1993];

- unbroken pre-Holocene alluvium above the projection of the Bald Eagle Canyon fault exposed in the East Pit has been dated as at least 40,000 years old and shows no evidence of fault offset [Shlemon, 1993; Proctor, 1993]; and

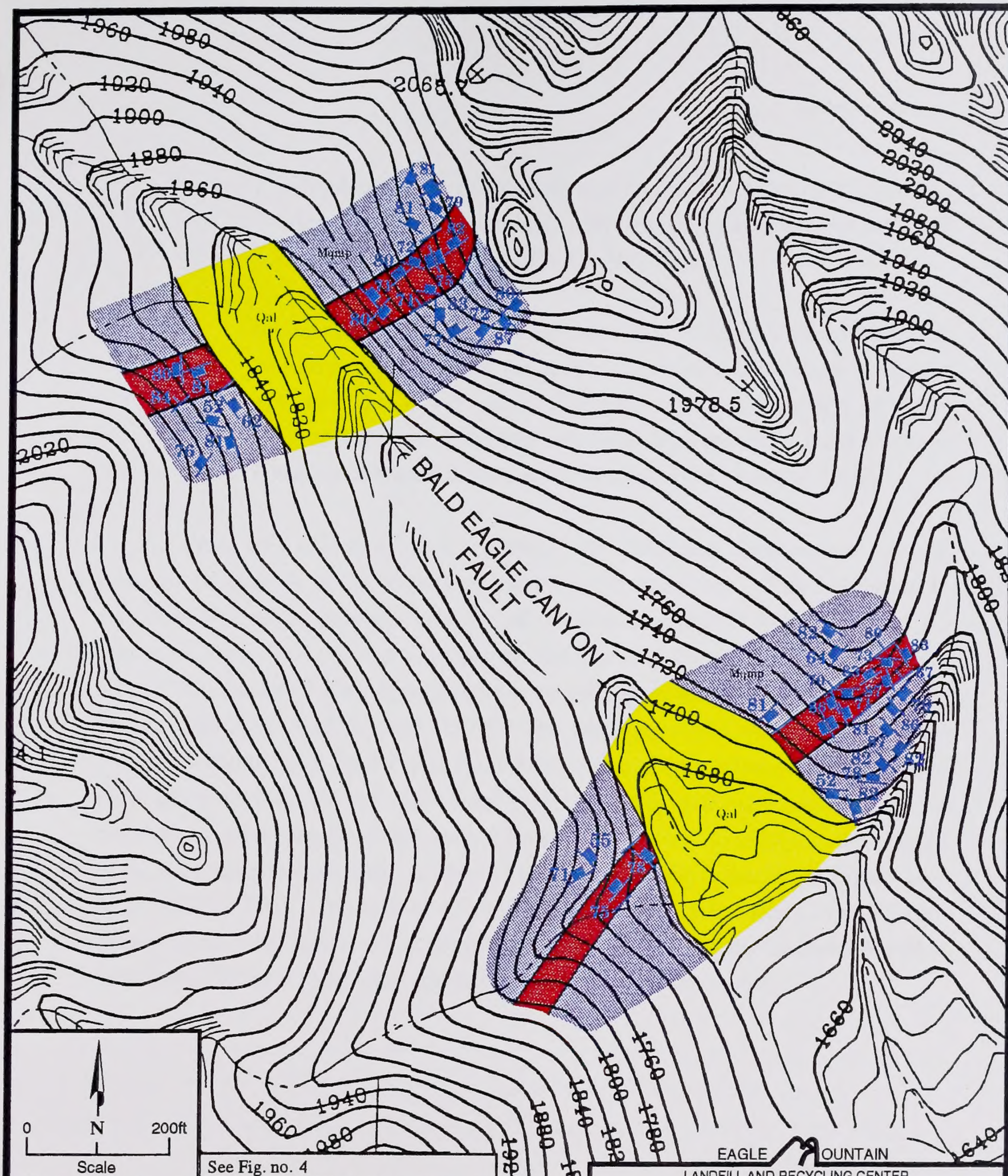
- pre-mining aerial photographs from the Whittier College Fairchild collection and the files of the Kaiser Corporation at the Eagle Mountain site show no disruption of well-patinated alluvial surfaces, which have been dated as at least 40,000 years old, above the projection of the Bald Eagle fault across the East Pit [Shlemon, 1993; Proctor, 1993].

From this evidence, it is concluded that Holocene displacement has not occurred on the Bald Eagle Canyon fault in the vicinity of the Eagle Mountain site. This conclusion is supported by detailed geologic mapping of the areas where Dikes 1 and 2 cross the Bald Eagle Canyon fault. Results of the mapping are presented in Figure 5 of this report (originally presented as Figure 14-2 in the ROWD-SV1). The field investigation did not reveal any evidence of dike offset at the fault contacts [GSi/water, 1993]. Dikes 1 and 2 have been dated as 124 and 234 million years old, respectively, using K-Ar dating techniques [Geochron, 1993]. These results, when coupled with the geologic history of southern California, indicate that the dikes were formed in at least the Tertiary Period, and possibly earlier. Based on the ages of the dikes and the lack of offset at the fault contacts, the period of seismogenic activity on the Bald Eagle Canyon fault was at least in the Tertiary Period and possibly earlier.

3.3 Fault A

Evidence that displacement has not occurred on Fault A in over 11,000 years includes observations of unbroken alluvium from pre-mining aerial photographs and field trenching. This evidence is summarized as follows:

- unbroken alluvium observed in a trench across the projection of Fault A south of the landfill (Trench 2) has been dated as at least 40,000 years old [Shlemon, 1993; Proctor, 1993];



See Fig. no. 4

Explanation

Qal	Alluvium *		Geologic contact
Mgmp	Granitic rocks *	17	Strike and dip of fracture
	Quartz Latite dike		Vertical fracture
		52	Strike and dip of lithologic contact

(* See Plate 1 ROWD for detailed descriptions)

Base map from Cooper Aerial Survey Co.

EAGLE MOUNTAIN
LANDFILL AND RECYCLING CENTER
RIVERSIDE COUNTY, CALIFORNIA
PREPARED FOR:
MINE RECLAMATION CORPORATION

ROWD SUPPLEMENTAL VOL. 1

DETAILED GEOLOGY
BALD EAGLE CANYON FAULT

GSi/water (Geothermal Surveys, Inc.)	DATE : 8/1/93	MAPPED : 5/93
	DESIGN BY : THH	JOB NO. : 107 (CE 4030)
	DRAWN BY : DWB	FILE NO. : N/A
	CHECKED BY : THH	DOCUMENT NO. : MRC-065
	REVIEWED BY : RAS (PROJ. MGR.)	FIGURE No. 5
	APPROVED BY : JHB (PRINCIPAL)	

- a bedrock exposure of the fault in a stream bed south of Trench 2 is overlain by unbroken alluvium, which has been dated as at least 40,000 years old [Shlemon, 1993; Proctor, 1993]; and

- pre-mining aerial photographs from the Whittier College Fairchild collection and the files of the Kaiser Corporation at the Eagle Mountain site show that a well-patinated alluvial fan surface, which has been dated as at least 40,000 years old, is not displaced above Fault A where it crosses the landfill footprint [Shlemon, 1993; Proctor, 1993].

From this evidence, it is concluded that Holocene displacement has not occurred on Fault A in the vicinity of the Eagle Mountain site. This conclusion is supported by detailed geologic mapping of the area where Dike 1 crosses Fault A, shown in Figure 6 of this report (originally presented as Figure 14-3 in the ROWD-SV1). The results of the mapping did not reveal any evidence of dike offset at the contact with Fault A [GSi/water, 1993]. The mapping results also indicate that an observed irregularity in Dike 1 near Fault A is not due to fault offset but is instead due to irregular intrusion of the dike along preferred joints and other fractures in the bedrock. A good example of this natural irregularity is found in Dike 1 in the vicinity of the Bald Eagle Canyon fault, as shown Figure 7 (originally presented as Figure 14-7 in the ROWD-SV1). The lack of offset of the dike at the fault contact, coupled with the age of the dike, indicates that the period of seismogenic activity on Fault A was at least in the Tertiary Period and possibly earlier.

3.4 East Pit Fault

Evidence that displacement has not occurred on the East Pit fault in over 11,000 years includes observations of unbroken alluvium over the fault in pre-mining aerial photographs and field observations of unbroken alluvium overlying the fault in the wall of the East Pit. This evidence is summarized as follows:

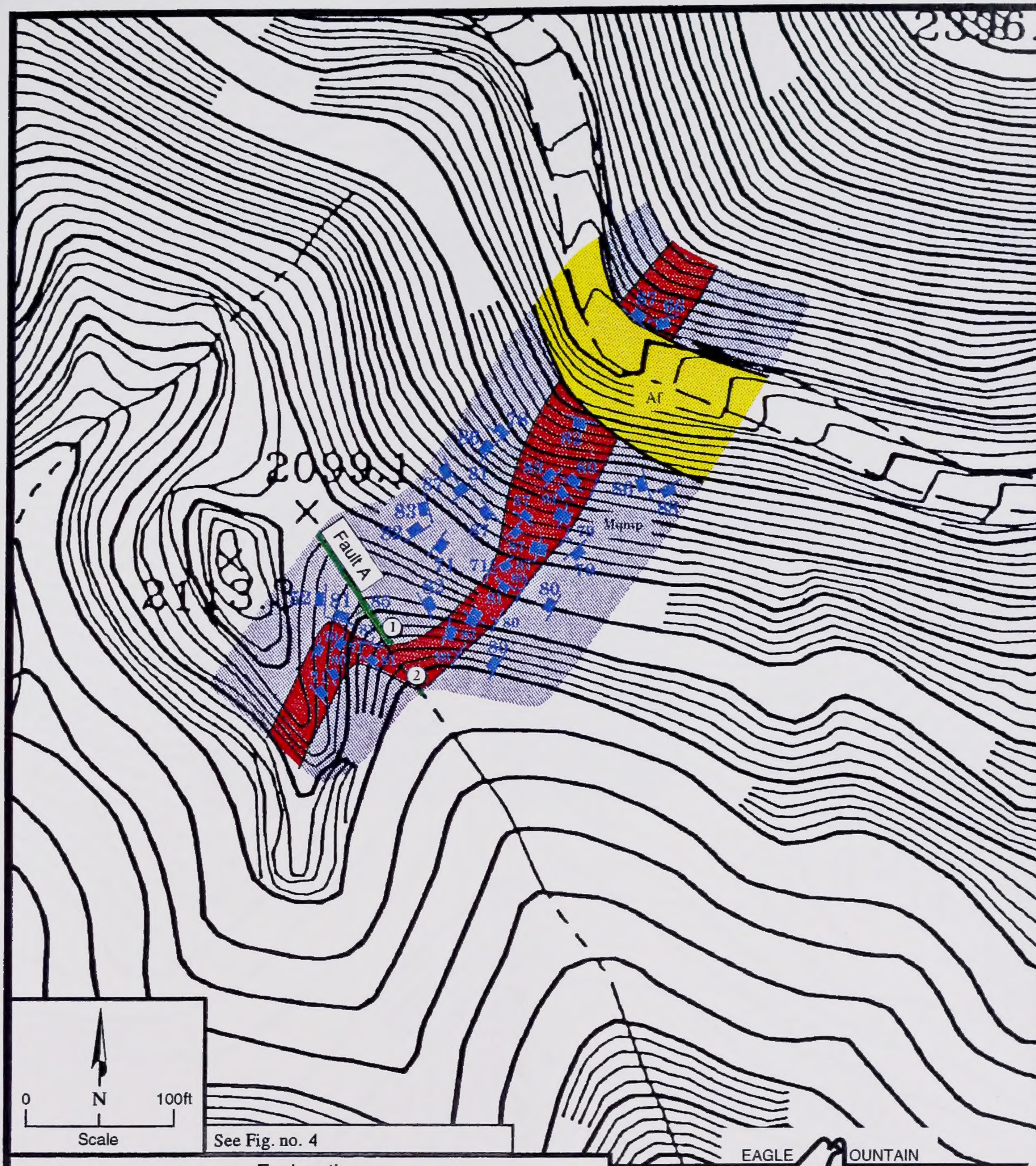
- pre-mining aerial photographs from the Whittier College Fairchild collection and the files of the Kaiser Corporation at the Eagle Mountain site show unbroken alluvium, which has been dated as at least 40,000 years old, above the projection of the East Pit fault [Shlemon, 1993; Proctor, 1993]; and

- approximately 270 ft (82 m) of unbroken alluvium, which has been dated as at least 100,000 years old, is exposed in the wall of the East Pit overlying the East Pit fault [Shlemon, 1993; Proctor, 1993].

From this evidence, it is concluded that Holocene displacement has not occurred along the East Pit fault in the vicinity of the Eagle Mountain Landfill site.

3.5 Lineament B

Aerial photographs show a strong lineament trending northwest-southeast that projects across the northeast corner of the landfill footprint north of the East Pit fault. At the suggestion of Mr. William Bryant of CDMG, this lineament was investigated by GSi/water and Proctor during preparation of the ROWD-SV1. The investigation showed that Lineament B is not a fault-related feature. Evidence supporting this conclusion includes:



Explanation

Af	Artificial Fill *	17	Strike and dip of fracture
Mqmp	Granitic rocks *		Vertical fracture
	Quartz Latite dike	52	Strike and dip of lithologic contact
	Fault	85	Strike and dip of fault
	Geologic contact	①	Location of photograph referred to in text

(* See Plate 1 ROWD for detailed descriptions)

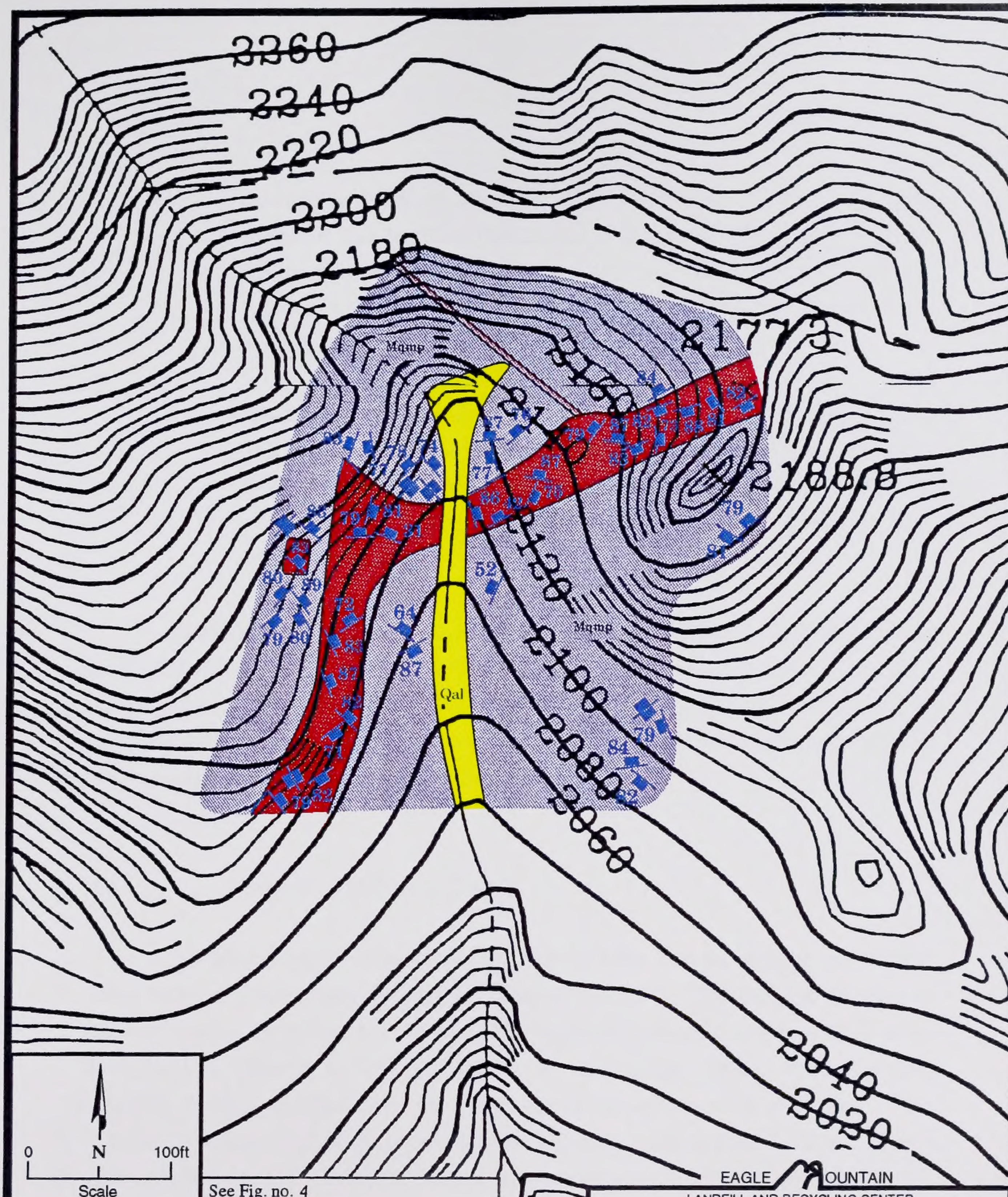
Base map from Cooper Aerial Survey Co.

EAGLE MOUNTAIN
LANDFILL AND RECYCLING CENTER
RIVERSIDE COUNTY, CALIFORNIA
PREPARED FOR:
MINE RECLAMATION CORPORATION

ROWD SUPPLEMENTAL VOL. 1

DETAILED GEOLOGY
FAULT "A"

GSi/water (Geothermal Surveys, Inc.)	DATE : 6/1/93	MAPPED : 5/93
	DESIGN BY : THH	JOB NO. : 107 (CE 4030)
	DRAWN BY : DWB	FILE NO. : N/A
	CHECKED BY : THH	DOCUMENT NO. : MRC-065
	REVIEWED BY : RAS (PROJ. MGR.)	FIGURE No. 6
	APPROVED BY : JHB (PRINCIPAL)	



EAGLE MOUNTAIN
LANDFILL AND RECYCLING CENTER
RIVERSIDE COUNTY, CALIFORNIA
PREPARED FOR:
MINE RECLAMATION CORPORATION

ROWD SUPPLEMENTAL VOL. 1

DETAILED GEOLOGY
EAST OF BALD EAGLE CANYON FAULT

Explanation

Qal	Alluvium *		Geologic contact
Mqmp	Granitic rocks *	17	Strike and dip of fracture
	Quartz Latite dike		Vertical fracture
	Mafic dike	52	Strike and dip of lithologic contact

(* See Plate 1 ROWD for detailed descriptions)

Base map from Cooper Aerial Survey Co.

GSi/water (Geothermal Surveys, Inc.)	DATE : 6/1/93	MAPPED : 5/93
	DESIGN BY : THH	JOB NO. : 107 (CE 4030)
	DRAWN BY : DWB	FILE NO. : N/A
	CHECKED BY : THH	DOCUMENT NO. : MRC-065
	REVIEWED BY : RAS (PROJ. MGR.)	FIGURE No. 7
	APPROVED BY : JHB (PRINCIPAL)	

- pre-mining aerial photographs from the Whittier College Fairchild collection and the files of the Kaiser Corporation at the Eagle Mountain site show unbroken, well-patinated alluvium, which has been dated as at least 40,000 years old, overlying Lineament B in the vicinity of the landfill footprint [Proctor, 1993]; and

- detailed observations along a linear canyon approximately one-half mile (0.8 km) northwest of the landfill performed during preparation of the ROWD-SV1 led to the conclusion that Lineament B is not a fault but a canyon eroded along a series of closely spaced joints [Proctor, 1993; ROWD-SV1, 1993].

In addition to the above observations, Bryant noted that he had observed in aerial photographs apparently undisturbed alluvium overlying a northwest projection of Lineament B about 2 miles (3 km) north of the landfill footprint. In summary, these various investigations and observations indicate that Lineament B is an erosional feature whose location is controlled by bedrock jointing.

3.6 Apparent Offset of Dike 2

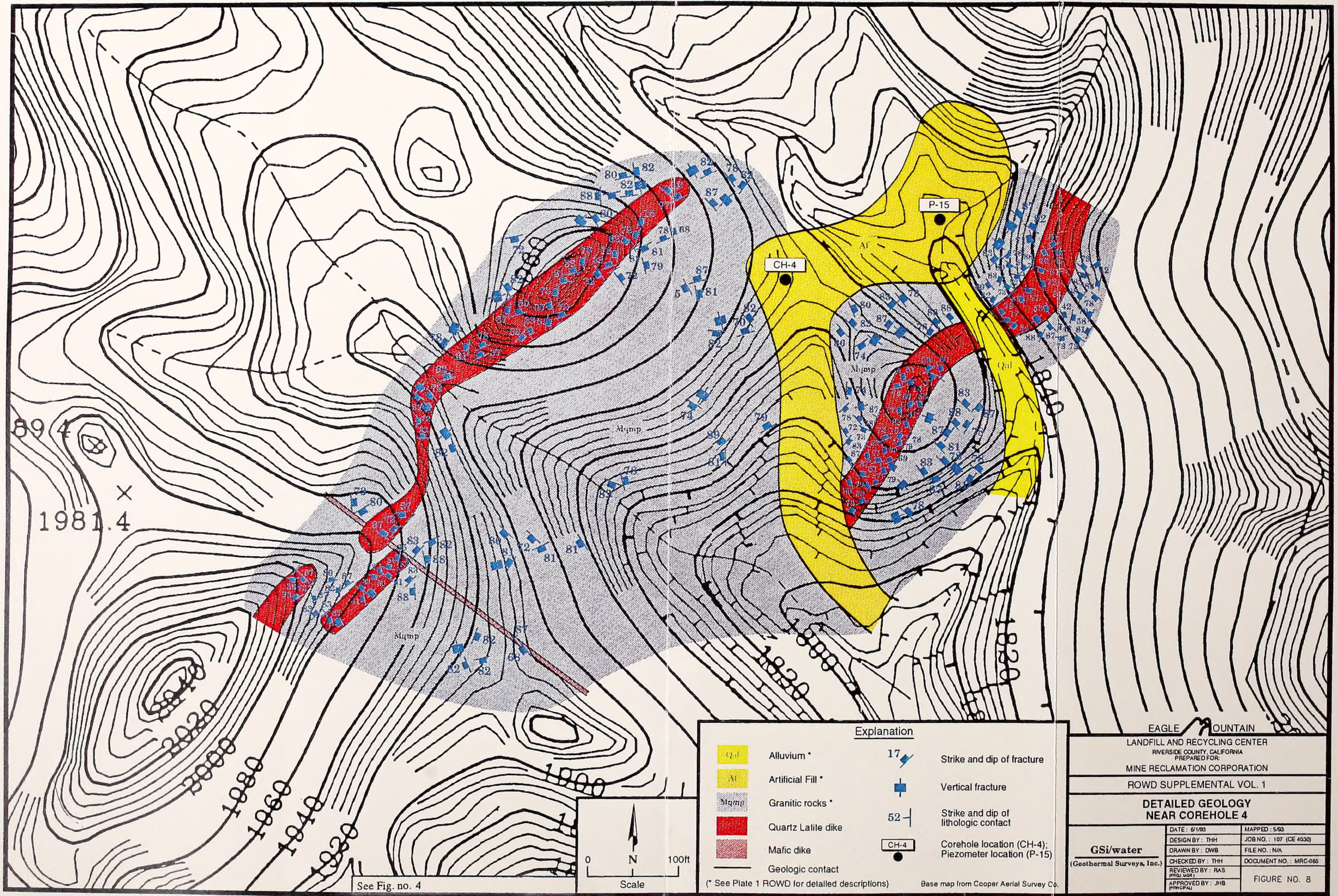
Detailed mapping of an apparent offset of Dike 2 in the vicinity of corehole CH-4 was performed during preparation of the ROWD-SV1. The detailed mapping of the area, presented in Figure 8 of this report (originally presented as Figure 14-8 in the ROWD-SV1), showed no sign of faulting or fault offset. Based upon the field mapping, it appears Dike 2 is not offset but is discontinuous in this area. This conclusion is supported by the observation that directly north of Dike 2, Dike 1 clearly shows no offset across a northwest-southeast projection of the apparent offset in Dike 2.

In summary, evidence of lack of Holocene faulting in the vicinity of the apparent offset in Dike 2 includes:

- no evidence of faulting in the area of the apparent offset [ROWD-SV1, 1993]; and

- no evidence of an offset in Dike 1 northwest of the area of apparent offset of Dike 1 [ROWD-SV1, 1993].

In conclusion, the physical evidence indicates that the apparent offset of Dike 2 in the vicinity of corehole CH-4 is due to irregular and discontinuous intrusion of the dike along preferred joints and other fractures in the bedrock.



CH-4
P-15
Af
Qal
Mqmp
1981.4
894
1820
1840
1860
1880
1900
1920
1940
1960
1980
2000
2020
2040
Explanation
Alluvium *
Artificial Fill *
Granitic rocks *
Quartz Latite dike
Mafic dike
Geologic contact
17 Strike and dip of fracture
Vertical fracture
52 Strike and dip of lithologic contact
CH-4 Corehole location (CH-4); Piezometer location (P-15)
(* See Plate 1 ROWD for detailed descriptions)
Base map from Cooper Aerial Survey Co.
0 N 100ft
Scale
See Fig. no. 4
EAGLE MOUNTAIN
LANDFILL AND RECYCLING CENTER
RIVERSIDE COUNTY, CALIFORNIA
PREPARED FOR:
MINE RECLAMATION CORPORATION
ROWD SUPPLEMENTAL VOL. 1
DETAILED GEOLOGY
NEAR COREHOLE 4
GSi/water
(Geothermal Surveys, Inc.)
DATE: 6/1/93
DESIGN BY: THH
DRAWN BY: DWB
CHECKED BY: THH
REVIEWED BY: RAS (PROJ. MGR.)
APPROVED BY: JHB (PRINCIPAL)
MAPPED: 5/93
JOB NO.: 107 (CE 4030)
FILE NO.: N/A
DOCUMENT NO.: MRC-065
FIGURE NO. 8

4. CONCLUSION

The multiple lines of corroborating evidence summarized in this report conclusively demonstrate that there are no faults on or within 200 ft (60 m) of the Eagle Mountain Landfill footprint that have undergone displacement during the Holocene Epoch. This evidence includes:

- trenching and field mapping of exposures of Fault A, the Bald Eagle Canyon fault, and the East Pit fault all show unbroken alluvium dated as at least 12,000 to 100,000 years old overlying the projections of these faults within and adjacent to the footprint of the landfill [Shlemon, 1993; Proctor, 1993]; and

- pre-mining aerial photographs that show well-patinated alluvial surfaces which have been dated as at least 40,000 to 100,000 years old overlying the projections of the faults in the vicinity of the landfill footprint [Shlemon, 1993; Proctor, 1992].

The foregoing evidence conclusively demonstrates that the Bald Eagle Canyon fault, Fault A, and the East Pit fault have not undergone displacement in at least 40,000 to 100,000 years. This conclusion is consistent with the results of detailed field mapping of two quartz latite dikes that cross the faults [GSi/water, 1993]. The conclusion is also consistent with the pattern of observed Holocene faulting in southern California and with the pattern of micro-seismicity in the general project vicinity.

Based on the results of the investigations, there are no active (Holocene) faults within 200 ft (60 m) of the footprint of the Eagle Mountain Landfill site. Accordingly, the Eagle Mountain Landfill site satisfies both state and federal regulations with respect to the siting of municipal solid waste landfills on or adjacent to Holocene faults.

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Appendix H-5

Geomorphic and Soil Stratigraphic Assessments, Alluvial Deposits, Proposed Eagle Mountain Landfill Site

UPDATED REPORT

GEOMORPHIC AND SOIL-STRATIGRAPHIC AGE ASSESSMENTS,

ALLUVIAL DEPOSITS, PROPOSED EAGLE MOUNTAIN LANDFILL SITE,

RIVERSIDE COUNTY, CALIFORNIA

by

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for

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Palm Springs, California

May 1993

(UPDATED REPORT, MAY 1993)

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INTRODUCTION

This report summarizes field observations of trench and open pit-mine exposures at the proposed Eagle Mountain Landfill near Desert Center in Riverside County, California. The main purpose of the assessment was two-fold: (1) to ascertain the approximate age of alluvial sediments in and near the site by geomorphic and soil-stratigraphic dating techniques; and (2) to compliment the geological background and fault-activity assessments carried out by GSi/water (1992/1993) and Proctor (1993). These geomorphic and soil-stratigraphic age assessments provide information about relative activity of site faults and whether any might be Holocene and therefore "active" according to present State of California criteria (Hart, 1992).

The investigation was commissioned by the Mine Reclamation Corporation (MRC), Palm Springs, California. Initial field investigations were carried out mainly on July 7, 8 and 27, 1992, accompanied by Engineering Geologist Richard J. Proctor (RJP). At the request of staff at the Regional Water Quality Control Board (RWQCB), a videotape was later prepared to document the geomorphic and soil-stratigraphic techniques used for fault assessment at the

site. This videotape is designated "Appendix A" and is attached to the ROWD Supplemental Volume 1. It particularly focuses on the age of sediments and soils exposed in the East Pit used to constrain the age of the East Pit fault, and on soil-geomorphic age assessments documented from Trenches 1 and 2 emplaced across projections of the of the Bald Eagle Canyon fault and Fault A, respectively (see geologic logs and location maps in ROWD Appendix D-1, and on revised ROWD Plates 1 and 2.)

A detailed alluvial soil-stratigraphy (Table 1) was measured and described from road and mine-cut exposures in the East Pit; and comparable soil observations were made at Trenches 1 and 2 (ROWD revised Plates 1 and 2). Additionally, RJP and MRC made available high-quality pre-mining (1946, 1954) and post-mining aerial photographs useful to document the former presence of old, high-level geomorphic surfaces that flanked the Eagle Mountains before mining operation disturbance.

Conclusions of this study were previously reviewed in the field with RJP, with the GSI/water and MRC staff, with Regional Water Quality Control Board geologist L. Chavez, and with State Water Control Board geologist R. Boylan. The conclusions are, however, here restated as more formal documentation. Pertinent location and geologic maps, trench logs, and aerial photographs are given in the ROWD narrative and in the Proctor (1993) Appendix D-1 report; and hence are referred to, but not replicated in this document. Logistical support was kindly provided by RJP and by the MRC and GSI/water staff.

GEOMORPHIC AND SOIL-STRATIGRAPHIC FRAMEWORK

High-quality aerial photographs flown in 1946 and 1954, before significant mining operations, show particularly well the presence and extent of relatively-datable Quaternary fan systems in the Eagle Mountains (see Proctor, 1993, Appendix D-1; and videotape attached). Comparable to alluvial deposits elsewhere in the Mojave Desert, the relative age of the Eagle Mountain fans are distinguished in the field and on aerial photographs by their degree of dissection, by relative elevation above modern ephemeral drainages, by presence of desert pavement and varnish (patina), and by relative soil profile development (Cooke and Warren, 1973; Shlemon, 1978). In general, the older fans are more dissected, usually have a distinct desert pavement and related varnish (observed as a dark patina giving rise to relatively low albedo on aerial photographs), and by remnant, strongly-developed soil profiles (relict paleosols).

Desert soils (pedogenic profiles) are particularly useful for relative dating of alluvial fan deposits. Older fans are typically characterized by profiles with a near-surface vesicular horizon (Av), reddish-brown argillic horizons (Bt), and multiple calcic (Bk/Ck) or even calcrete (K) horizons. In contrast, younger fan deposits, particularly those of Holocene age, are marked by poorly-developed geomorphic surfaces (usually bar and channel deposits), by generally aggrading conditions, and by undeveloped or, at best, slightly-developed soil profiles usually marked either by A/C, by color (cambic), or by weak B (Btj) horizons; (see, for example,

summaries of soil profile terminology and applications to dating Quaternary sediments in Birkeland, 1984; Gile and others, 1966; Guthrie and Witty, 1982; Nettleton and others, 1975; Peterson, 1980; Shlemon, 1978; and Soil Survey Staff, 1975).

Particularly useful to date desert alluvial sediments are relict and buried paleosols. Relict paleosols still remain on the modern geomorphic surface, having mostly formed under soil climates of the past; buried paleosols are now covered by younger sediments but, as exposed in quarry and road cuts, often mark the former presence of regionally-extensive, climatically-controlled, stable geomorphic surfaces (Birkeland, 1984; Morrison, 1978; Ruhe, 1965).

Soil profiles yield relative ages; but these can often be generally quantified by correlation of local profiles with numerically-dated profiles elsewhere in similar soil-climatic environments, or by association with regional epochs of climatic change, landscape stability, and the marine oxygen-isotope stage chronology (Shlemon, 1985). Soils essentially reflect the stability of the geomorphic surface upon which they are forming. Accordingly, soils only provide a minimum age for a geomorphic surface; and the underlying sediments may thus be much older. Despite this inherent "conservatism" in age estimation, many soil profiles, particularly relict and buried paleosols, prove to be valuable stratigraphic markers to assess the timing of last fault activity (Douglas, 1980; Ku and others, 1979; Machette, 1978; Shackleton and Opdyke, 1973; Shlemon, 1978; 1985; Spellman and others, 1984).

In addition to being amenable to soil-stratigraphic dating, many old fan surfaces are ideal "geomorphic markers" to ascertain the possible presence of active faults. This is exemplified in the Eagle Mountain area (ROWD Plates 1 and 2), where through-going faults are usually expressed in bedrock as distinct aerial-photographic lineaments that project directly toward old fans. If these fans are displaced, then scarps, depressions or other topographic alignments are typically discernible. Such geomorphic expression usually renders the fault "sufficiently well defined" to be designated as "active" according to present State of California criteria (Hart, 1992). In contrast, combined with site-specific mapping and trench documentation of unbroken pre-Holocene sediments overlying reasonable projections of faults, the presence of old fan surfaces also provides geomorphic documentation attesting to the relative antiquity of the bedrock faults.

EAST PIT SOIL GEOMORPHIC EXPRESSION AND SOIL STRATIGRAPHY

The Eagle Mountain East Pit provides a "trench" more than 2,000-linear feet long that locally exposes a 300-ft thick section of Quaternary debris and mud flows. Such essentially continuous exposures are rare indeed. The East Pit exposures thus provide a unique opportunity to document the trend of the East Pit bedrock fault and the presence of overlying unbroken Quaternary sediments at a level of confidence far beyond that normally available to the geologist involved in fault-activity assessments.

The upper part of the East Pit Quaternary section is readily

accessible on the northeast wall, and hence was selected as the site for a detailed soil profile measurement and description (Table 1; location maps, ROWD revised Plates 1 and 2). This area, as well as south wall exposures showing the relationship of the East Pit fault and overlying Quaternary stratigraphy are also documented on the accompanying videotape.

From a geomorphic standpoint, the East Pit largely occupies what was once a former high-level alluvial fan surface, replete with strongly-developed desert pavement and patina (see, for example, the 1946 pre-mining aerial photographs in Proctor (Appendix D-1) and the 1954 imagery on the accompanying videotape). The East Pit fault, expressed as a strong, northwest-trending photo-lineament in bedrock, projects directly toward the former old fan surface. No disruption of the old surface is discernible on the photographs, a geomorphic indication of fault antiquity.

Although locally covered by more than 50 ft of mine tailings, the original geomorphic surface and capping relict paleosol of the East Pit area are visible in the northeast wall (videotape). Here exposed in the upper 12 feet of the Quaternary sediments is a moderately-developed relict paleosol and an underlying, strongly-developed buried paleosol (Table 1). The relative development of these soils is particularly useful to determine a minimum age for the underlying Quaternary sediments (Proctor, 1993; Appendix D-1).

Described in terminology traditionally employed by the Quaternary geologist and the soil scientist (Birkeland, 1984; Soil Survey Staff, 1951; 1975), the upper relict paleosol is

TABLE 1

SOIL PROFILE MEASUREMENT AND DESCRIPTION, EAGLE MOUNTAIN NORTHEAST PIT, RIM AREA;

EAST SIDE OF ACCESS ROAD

HORIZON	DEPTH (FT)	DESCRIPTION
B1tk	0.0-3.0	Reddish brown (5YR 4/4) gravelly silty loam; moderate angular blocky structure; hard, firm, sticky and plastic; common, moderately-thick clay films on ped faces; decomposed, grussified granitic clasts to 6-in diameter; crudely stratified, subrounded to subangular debris flow, clast-supported matrix; strongly effervescent near base; gradual wavy boundary.
B2k	3.0-4.8	Strong brown (7.5YR 5/4) gravelly fine sandy loam; angular granitic and quartzitic clast, 6-8-in diameter; weak subangular blocky structure; slightly hard, loose to friable; slightly sticky and non-plastic; clast-supported matrix; moderately effervescent; gradual wavy boundary.
Ck	4.8-8.0	Brown (10YR 5/3) angular gravelly silt loam; massive to very weak angular blocky structure; soft, friable, non-sticky and non-plastic; slightly effervescent; abrupt wavy boundary (unconformity).
2Btkb	8.0-9.2	Buried Paleosol: Reddish brown (5YR 4/4) gravelly clayey loam; massive to moderate, fine angular blocky structure; very hard, very firm, slightly sticky and slightly plastic; violently effervescent; subrounded carbonate nodules to 0.5-in diameter near base; thin, carbonate rinds on base of metamorphic clasts; common to many clay films, on ped faces and bridging mineral grains; abrupt wavy boundary (stoneline).

HORIZON	DEPTH (FT)	DESCRIPTION
2B-Ckb	9.2-12.0+	Light yellowish brown to brown (10YR 6/4-7.5YR 4/4) subrounded to subangular gravelly silt loam; massive structure; hard, friable to firm, non-sticky and non-plastic; violently effervescent; stage III-IV calcrete near base; laterally grading into K horizon; matrix engulfed by pedogenic carbonates; base of horizon covered by talus; base of described section.
		NOTES: 1. Upper relict paleosol: moderately to strongly developed; upper part of argillic horizon truncated by artificial fill at measured section; soil forming on gravelly, coarse-grained fan sediments; probably proximal or medial fan environment. 2. Buried paleosol: strongly developed with remnant argillic horizons; stage III-IV calcic horizons locally grading into calcrete (K horizon). 3. Estimated minimum age of relict paleosol: 35,000-40,000 yrs; possibly 100,000 yrs old. Estimated age of buried paleosol: greater than 100,000 yrs. 4. Profile description by RJS and RJP, 7/8/92.

characterized by three clearly visible horizons; two reddish-brown argillic (clay-enriched; B1tk, B2k) horizons and calcium-rich parent material (Ck). Based on comparison with comparably-developed soils dated elsewhere in the Mojave Desert (Shlemon, 1978), the East Pit relict paleosol probably required a minimum 40,000 (marine oxygen-isotope stage 3) to perhaps more than about 100,000 (stage 5) years to form.

Where measured and described on the north wall of the East Pit (see additional documentation on accompanying videotape), the strongly-developed buried paleosol is identified at a depth of 8.0 to 12 ft below the original ground surface. The paleosol is likewise characterized by a remnant argillic horizon (2Btkb), and by multiple calcic horizons (2B-Ckb) locally grading into calcrete (K) horizons (Table 1).

Based on soil-stratigraphic age assessments, the upper part of the East Pit Quaternary sediments are probably more than about 100,000 years old. Given the approximate 300-ft thickness of the section, the underlying East Pit sediments are clearly much older. As documented by Proctor (1993; Appendix D-1)) and as depicted on the videotape, pre-100,000 yr old sediments extend unbroken across the East Pit fault where exposed in the south wall (ROWD revised Plates 1 and 2).

TRENCH 1 ALLUVIAL STRATIGRAPHY

Proctor (1993; Appendix D-1) emplaced and logged two trenches, now collectively called "Trench 1," across the southeastern

projection of the Bald Eagle Canyon fault (ROWD revised Plates 1 and 2). The trench exposes over 500 linear feet of old Quaternary fan sediments that are now locally covered by 3 to 4 ft of mining debris. Nevertheless, the trenches are sufficiently deep to penetrate "native sediment" mudflows and debris flows that are soil-stratigraphically characterized by a weak argillic (Btj) and stage I to III calcic horizons (Trench logs in Proctor [1993; Appendix D-1]; profile terminology from Soil Survey Staff [1975] and Gile and others [1966]).

Owing to mining operations in the Trench 1 area, the upper part of the original geomorphic surface has been disturbed, and the underlying soil is thus only partially preserved. Conservatively, therefore, based on preservation of the remnant soil profile, the Quaternary sediments exposed in Trench 1 are an estimated minimum 12,000 to 15,000 years old. However, based on their high-level geomorphic position, as observed on the 1946 pre-mining aerial photographs (Proctor, 1993; Appendix D-1), they are undoubtedly much older, possibly 40,000 or even 100,000 years old. This geomorphic estimate is corroborated by exposures on the wall of the East Pit, about 100 ft north of Trench 1 (ROWD revised Plates 1 and 2). Present is a 30 to 120-ft thick, Quaternary-age debris and mudflow sequence that underlies the Trench 1 exposures (Proctor, 1993; Appendix D-1). As further documented by Proctor (1993; Appendix D-1)), various splays of the Bald Eagle Canyon fault that project across Trench 1 do not displace these sediments. Therefore, similar to the East Pit fault, last displacement of the

comparably northwest-trending Bald Eagle Canyon fault took place before an estimated 40,000 years ago, and probably well before that time.

TRENCH 2 ALLUVIAL STRATIGRAPHY

Bulldozer Trench 2 was sited in very coarse-grained proximal fan deposits that extend across a projection of mapped bedrock Fault "A" (see locations in ROWD revised Plates 1 and 2; and log in Proctor [1993; Appendix D-1]). As documented on the accompanying videotape, the Trench 2 sediments are highly chaotic and poorly sorted, derived mainly from high-gradient, first and second order drainages. Internal stratigraphic markers are thus few. Nevertheless, the geomorphic surface still preserves a moderately- to locally strongly-developed relict paleosol, one distinguished by reddish-brown argillic horizons with many, common and thick clay films on ped faces, and by multiple calcic horizons. Based on the relative profile development of this relict paleosol, a minimum age for the geomorphic surface upon which it is forming is an estimated 40,000 years (isotope stage 3). As documented on the Trench 2 logs (Proctor, 1993; Appendix D-1), these sediments are not displaced by bedrock Fault A.

SUMMARY AND CONCLUSIONS

Geomorphic and soil-stratigraphic observations show that regionally-extensive alluvial fan systems once flanked bedrock that makes up the core of the Eagle Mountains. Though now much modified

by mining operations, the photographically-observable original geomorphic surfaces provide an estimated age for the deposits, and this is now supplemented by site-specific soil-stratigraphic measurements and descriptions.

The East Pit exposes up to 300 feet of Quaternary proximal and medial-fan mudflows and debris flows that underlay an old, high-level geomorphic surface replete with strongly-developed desert pavement, patina and soil profiles. A representative soil-stratigraphic section measured in cuts along the northeast wall of the East Pit reveals the presence of a moderately-developed relict paleosol that formed on the original geomorphic surface, and an underlying strongly-developed buried paleosol. Based on local relative profile development, on comparable development of soils numerically dated in similar soil climatic regimes, and on association with the Quaternary marine isotope-stage chronology, the East Pit near-surface sediments are judged to be in excess of 100,000 years old. The underlying sediments are thus much older, and may well extend back to several hundred thousand years in age.

The site geologic maps indicate that the East Pit Quaternary section is entirely unbroken where overlying the East Pit Fault. Based on geomorphic and soil-stratigraphic evidence, last displacement of the bedrock-identified East Pit fault occurred before about 100,000 years ago, and likely well before that time.

The remnant soil profile in Trench 1, emplaced across projection of the Bald Eagle Canyon fault, is only slightly developed, owing to surface disturbance engendered by mining

operations. For conservatism, therefore, a minimal age of about 12,000 to 15,000 is accorded to these trench-exposed sediments. However, pre-mining photographs show that the Trench 1 sediments underlie a former, relatively high-level geomorphic surface that extended unbroken across the bedrock Bald Eagle Canyon fault. This geomorphic evidence, combined with nearby pit-wall exposures showing 30 to 120 ft of unbroken alluvial deposits underlying Trench 1, indicate that the Quaternary section is probably well in excess of about 40,000 years old. These sediments, as shown on geologic maps and logs, are also unbroken and thereby document that last displacement of the Bald Eagle Canyon fault took place prior to at least 40,000 years ago.

Moderate to strong soil profile development, and high-level geomorphic position similarly provide age estimates for the documented unbroken Quaternary mud flows and debris flows that extend across projections of bedrock Fault A. The surface relict paleosol, replete with argillic and multiple calcic horizons, is an estimated minimum 40,000 years old. Last displacement of Fault A must have, therefore, taken place well before this time.

As observed during the geomorphic and soil-stratigraphic investigations, all Quaternary deposits were visibly continuous where either overlying bedrock faults, or where lying across the projections of these faults. The Eagle Mountain fan deposits have thus provided excellent geomorphic and soil-stratigraphic markers from which to assess the relative activity of bedrock faults identified in the proposed landfill site.

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Appendix I
Visual Analysis

Appendix I: Visual Analysis Methodology

Introduction

The methodology used to evaluate the project's visual impacts follows methods developed by the U.S. Department of Interior, Bureau of Land Management (BLM), Division of Recreation and Cultural Resources and described in *Visual Resource Management Program* (BLM, 1980). The major components in the BLM visual assessment process include the following three tasks: 1) prepare a visual resource inventory of the project area by conducting a scenic quality evaluation, delineation of distance zones, and sensitivity level analysis; 2) assign visual ratings to the project site (also referred to as management classifications) using BLM's predefined visual resource management (VRM) classes; and 3) evaluate the project's impact on visual resources using a rating system that measures the degree of contrast between the proposed activity and the existing landscape.

The first two tasks define the baseline conditions against which impacts are measured (task 3). The degree of visual impact is determined by comparing the project's measured degree of contrast with allowable levels of contrast for the appropriate management class. If the contrast rating score does not meet the standards for the designated management class, mitigation measures are developed and recommended. The specific steps involved in each of these tasks are described below.

Task 1: Prepare Visual Resource Inventory

Preparing an inventory of existing visual resources provides the baseline conditions against which project impacts are later measured. The inventory of visual resources involved reviewing existing planning documents, the project's previous visual analysis (RECON, 1991), and maps of the project area, as well as conducting several field reconnaissances. The visual resource inventory process consisted of three subtasks: 1) assess the visual (i.e., scenic) quality of the regional and project area landscape; 2) evaluate viewing distances; and 3) determine the sensitivity of nearby viewer groups to changes in the landscape. Each of these subtasks is briefly discussed below.

Subtask 1.1 Scenic Quality Evaluation

The process of rating scenic quality requires a brief description of the existing scenic values in a landscape. For the EML Project, the project area was divided into five distinct landscape character types (e.g., mountains, steep hills, basins, etc.) that appear visually homogenous, generally in terms of landform and vegetation. Each landscape type was subdivided into landscape units according to specific geographic features within the study area (e.g., Eagle Mountains, Chuckwalla Mountains, etc.) and then rated for scenic quality using a standardized five-point rating system based on the following seven criteria: landform, vegetation, water, color, influence of adjacent scenery, scarcity, and cultural modification.
The attached Scenic Quality Inventory and Evaluation Chart and Explanation of Rating Criteria describe the scenic quality rating criteria used in this analysis. The Scenic Quality

Rating Worksheet documents the scenic quality score for each landscape unit within the project area. Each score was then categorized into one of three Scenic Quality Classes, as defined in Table I-1, below.

Table I-1
Scenic Quality Classes

Scenic Quality Class	Total Scenic Quality Score	Scenic Quality Definition
Class A	19 or more	Areas that combine the most outstanding characteristics of each rating criterion.
Class B	12 to 18	Areas with a combination of some outstanding features and some fairly common to the physiographic region.
Class C	11 or less	Areas with features fairly common to the physiographic region.

Subtask 1.2 Distance Zone Analysis

The limits of the project area visual environment are defined by its viewshed. A viewshed is the surface area visible from a given viewpoint or series of viewpoints. A viewshed map was prepared to document the general visibility of the project site from the surrounding project area. The visual quality of a landscape may be magnified or diminished by its visibility from major viewing areas, also referred to as key observation points (KOPs). Within the project area, eight KOPs were selected. The project area viewshed was then divided into three different distance zones based on relative visibility from each KOP:

1. Foreground/Middleground (fm) Zone: 0 through 3 to 5 miles
2. Background (bg) Zone: 3 to 5 through 15 miles
3. Seldom Seen (ss) Zone: (15 miles+)

Subtask 1.3 Sensitivity Level Analysis

Visual sensitivity levels are defined as the degree of public concern for the scenic quality of an area. There are three levels of visual sensitivity: high, medium, and low. Factors that determine the level of visual sensitivity include the following:

1. **Type of User.** Recreational users may be highly sensitive to any changes in visual quality, whereas workers who pass through the area on a regular basis may not be as sensitive to change.
2. **Amount of Use.** Areas seen and used by large numbers of people are potentially highly sensitive.

3. **Public Interest.** The visual quality of an area may be of concern to local, State, or National groups; these concerns are typically expressed during public scoping meetings, as well as in letters (e.g., responses to the NOP), newsletters, etc.

4. **Adjacent Land Uses.** The interrelationship with adjacent land uses can effect the visual sensitivity of any area (e.g., an area within the viewshed of a residential community may be more sensitive than an area surrounded by commercially developed lands).

5. **Special Areas.** Depending on their specific management objectives, special areas such as Natural Areas, Wilderness Areas or Wilderness Study Areas, Scenic Roads or Trails, etc. may be highly sensitive to changes in the existing landscape.

Visual sensitivity was measured by evaluating views of the project site from sensitive viewer groups located at the eight KOPs. Three typical sensitive viewer groups are: recreationists, residents, and motorists. Recreational viewers are sensitive because, depending on the nature of their activity, they typically expect high quality aesthetics. Residential viewers are sensitive due to the high frequency and duration of their views. The sensitivity level of motorists depends on the quality of views provided by the transportation corridor; for example, motorists traveling on scenic highways or on a roadway oriented toward regional landmarks could be considered a sensitive viewer group.

The attached Sensitivity Level Rating Sheet Instructions describe the rating criteria used for the project's sensitivity level analysis. The Sensitivity Level Rating Worksheet documents the ratings for sensitive viewer groups within the project area.

Task 2: Determine Visual Resource Classes

Visual resource classes are used to represent the relative value of existing visual resources and to describe the different degrees of contrast or modification allowed to the basic elements of the landscape. There are four visual resource classes. Class I is typically assigned to all special areas where the current management situations requires maintaining a natural environment essentially unaltered by man. Classes II, III, and IV are assigned based on combinations of scenic quality, distance zones, and sensitivity levels using the matrix shown in Table I-2:

Table I-2
Visual Resource Inventory Classes Matrix

Visual Sensitivity:	***High***			***Medium***			***Low***
Special Areas	I	I	I	I	I	I	I
Scenic Quality: *A*	II	II	II	II	II	II	II
Scenic Quality: *B*	II III/IV*	III		III	IV	IV	IV
Scenic Quality: *C*	III	IV	IV	IV	IV	IV	IV
Distance Zones:	***f/m***	***b***	***s/s***	***f/m***	***b***	***s/s***	***s/s***

* If adjacent area is Class III or lower, assign Class III, if higher, assign Class IV.

Task 3: Assign Visual Resource Contrast Ratings

Evaluation of project impacts was based on a visual contrast rating system. The contrast rating system measures the degree of contrast between the project area's existing landscape and the surrounding natural landscape, and the proposed project and the surrounding natural landscape. The two contrast ratings are compared to determine whether the project increases or decreases the degree of contrast with the surrounding natural landscape.

Photographs of existing conditions from eight KOPs, along with computer-generated simulations of the project, were used to assist in assigning contrast ratings. The computer-simulations were prepared using a three-dimensional computer model developed from USGS digital data of base topographic conditions and final landfill grading plans prepared by Geosyntec Consultants.

To perform the contrast ratings, the existing project site was segregated into its major landscape features (e.g., land, vegetation, and structures). Each landscape feature was then subdivided into four basic visual elements: form, line, color, and texture. Each element was assigned a weighted value based on its significance in this specific landscape setting: (i.e., color = 4, most important, to texture = 1, least important). Degrees of contrast for both existing and project conditions were rated based on the criteria presented in Table I-3:

Table I-3
Visual Contrast Criteria

Degree of Contrast	Rating	Criteria
None	0	The element contrast is not visible or perceived.
Weak	1	The element contrast can be seen but does not attract attention.
Moderate	2	The element contrast begins to attract attention and begins to dominate the characteristic landscape.
Strong	3	The element contrast demands attention, will not be overlooked, and is dominant in the landscape.

The magnitude of the project's visual impact for any given element was determined by multiplying the element's weighted value by the degree of contrast. The addition of individual contrast rating scores for each visual element defines the total contrast score for a particular landscape feature.

The Visual Contrast Rating Worksheets document the degree of contrast between the surrounding natural landscape and both the existing landscape and proposed project for eight KOPs. The contrast rating score for each KOP was then classified into one of three general categories as shown in Table I-4:

Table I-4
General Visual Contrast Categories

Category	Visual Contrast Score	Definition
Category 1 (low)	0 - 10 points	Contrast can be seen but does not attract attention
Category 2 (moderate)	11 - 20 points	Attracts attention and begins to dominate
Category 3 (high)	21 - 30 points	Demands attention and will not be overlooked by the average observer

After the total visual contrast scores were tabulated for each KOP, the scores for the existing landscape and proposed project were compared against each other and against the BLMs recommended resource classes identified for the project site to determine if the project exceeds the recommended contrast. The general compatibility between contrast rating categories and VRCs are identified in Table I-5

Table I-5
Contrast Rating Compatibility with VRCs

Contrast Rating Category	Compatible Visual Resource Classes
Category 1: (low)	Classes I through IV
Category 2: (moderate)	Class II*, Classes III and IV
Category 3: (high)	Class IV

*Determination of whether a Category 2 landscape feature is compatible within a Class II landscape is made on a project-by-project basis.

Scenic Quality

Inventory and Evaluation Chart, Explanation of Rating Criteria, Rating Sheet

SCENIC QUALITY INVENTORY AND EVALUATION CHART

Key factors	rating criteria and score		
landform	High vertical relief as expressed in prominent cliffs, spires, or massive rock outcrops; or severe surface variation or highly eroded formations including major badlands or dune systems; or detail features dominant and exceptionally striking and intriguing such as glaciers.	Steep canyons, mesas, buttes, cinder cones, and drumline; or interesting erosional patterns or variety in size and shape of landforms; or detail features which are interesting though not dominant or exceptional.	Low rolling hills, foothills, or flat valley bottoms; or few or no interesting landscape features.
vegetation	A variety of vegetative types as expressed in interesting forms, textures, and patterns. 5	Some variety of vegetation, but only one or two major types. 3	Little or no variety or contrast in vegetation. 1
water	Clear and clean appearing still, or cascading white water, any of which area a dominant factor in the landscape. 5	Flowing, or still, but not dominant in the landscape. 3	absent, or present, but not noticeable. 1
color	Rich color combinations, variety or vivid color; or pleasing contrasts in the soil, rock, vegetation, water or snow fields. 5	Some intensity or variety in colors and contrast of the soil, and vegetation, but not a dominant scenic element. 3	Subtle color variations, contrast, or interest; generally mute tone. 0
influence of adjacent scenery	Adjacent scenery greatly enhances visual quality. 5	Adjacent scenery moderately enhances overall visual quality. 3	Adjacent scenery has little or no influence on overall visual quality. 1
scarcity	One of a kind; or unusually memorable, or very rare within region. Consistent chance for exceptional wildlife or wildflower viewing, etc.[1] 5	Distinctive, though somewhat similar to others within the region. 3	Interesting within its setting, but fairly common within the region. 0
cultural modifications	Modifications add favorably to visual variety while promoting visual harmony 5 +	Modifications add little or no visual variety to the area, and introduce no discordant elements. 3	Modifications add variety but are very discordant and promote strong disharmony. 1
	2	0	-4

INSTRUCTIONS

How to Delineate Rating Areas: Consider the following factors when delineating rating areas.

1. Like physiographic characteristics (i.e., land form, vegetation, etc.)
2. Similar visual patterns, texture, color, variety, etc.
3. Areas which have a similar impact from cultural modifications (i.e., roads, historical and other structures, mining operations, or other surface disturbances).

Explanation of Criteria: (See attached sheet)

Note: Values for each rating criteria are maximum and minimum scores only. It is also possible to assign scores within these ranges.

SCENIC QUALITY

A = 19 or more

B = 12-18

C= 11 or less

[1] A rating of greater than 5 can be given but must be supported by written justification.

Source: BLM Manual Handbook 8410-1, Visual Resource Inventory, January 1986.

Scenic Quality - Explanation of Rating Criteria

Landform

Topography becomes more interesting as it gets steeper or more massive, or more severely or universally sculptured. Outstanding landforms may be monumental, as the grand Canyon, the Sawtooth Mountain Range in Idaho, the Wrangell Mountain Range in Alaska, or they may be exceedingly artistic and subtle as certain badlands, pinnacles, arches, and other extraordinary formations.

Vegetation

Give primary consideration to the variety of patterns, forms, and textures created by plant life. Consider short-lived displays when they are known to be recurring or spectacular. Consider also smaller scale vegetational features which add striking and intriguing detail elements to the landscape (e.g., gnarled or windbeaten trees, and joshua trees).

Water

That ingredient which adds movement or serenity to a scene. The degree to which water dominates the scene is the primary consideration in selecting the rating score.

Color

Consider the overall color(s) of the basic components of the landscape (e.g., soil, rock, vegetation, etc.) as they appear during seasons or periods of high use. Key factors to use when rating "color" are variety, contrast, and harmony.

Adjacent Scenery

Degree to which scenery outside the scenery unit being rated enhances the overall impression of the scenery within the rating unit. The distance which adjacent scenery will influence scenery within the rating unit will normally range from 0-5 miles, depending upon the characteristics of the topography, the vegetative cover, and other such factors. This factor is generally applied to units which would normally rate very low in score, but the influence of the adjacent unit would enhance the visual quality and raise the score.

Scarcity

This factor provides an opportunity to give added importance to one or all of the scenic features that appear to be relatively unique or rare within one physiographic region. There may also be cases where a separate evaluation of each of the key factors does not give a true picture of the overall scenic quality of an area. Often it is a number of not so spectacular elements in the proper combination that produces the most pleasing and memorable scenery--the scarcity factor can be used to recognize this type of area and give it the added emphasis it needs.

Cultural Modifications

Cultural modifications in the landform/water, vegetation, and addition of structures should be considered and may detract from the scenery in the form of a negative intrusion or complement or improve the scenic quality of a unit. Rate accordingly.

Source: BLM Manual Handbook 8410-1, Visual Resource Inventory, January 1986.

Scenic Quality Rating Sheet for Project Area								
	Scenic Quality Factors							
Scenic Quality Landscape Unit	Landform	Vegetation	Water	Color	Influence of Adjacent Scenery	Scarcity	Cultural Modifications	Total Score (Scenic Quality Class)
Eagle Mountains (M-1)	4	3	0	3	4	3	0	17(B)
Coxcomb Mountains (M-2)	5	3	0	3	5	4	0	20(A)
Chuckwalla Mountains (M-3)	4	3	0	3	4	3	0	17(B)
Eagle Mountain Foothills (H-1)	2	3	0	3	4	2	0	13(B)
Pinto Basin (B-1)	1	3	0	2	4	1	0	11(C)
Chuckwalla Valley (B-2)	1	3	0	2	3	1	-1	8(C)
Hayfield Dry Lake (D-1)	1	1	0	1	3	3	0	9(C)
Chuckwalla Valley Dunes (D-2)	1	1	0	1	3	3	0	9(C)
Eagle Mountain Mine and Townsite (O-1)	2	1	0	2	3	3	-3	8(C)
Black Eagle Mines (O-2)	2	1	0	2	3	3	-3	8(C)

Notes: See attached Inventory and Evaluation Chart and Explanation of Rating Criteria for definitions of Scenic Quality Ratings for each factor.

Sensitivity Level Analysis

Sensitivity Level Rating Sheet Instructions and Rating Sheet

Sensitivity Level Rating Sheet

Instructions

Steps in the Sensitivity Level Analysis

1. Divide the inventory area into logical sensitivity rating units. In this case only the project site is evaluated.

2. Analyze the factors which indicate visual sensitivity.

3. In respect to the project site as a visual resource visible from each location, rate each factor as high, moderate, or low using the following outline as a general guide:

   a. **Type of User**. Maintenance of visual quality is:

   -- a major concern for most users.................High
   -- a moderate concern for most users.................Moderate
   -- a low concern for most users.................Low

   b. **Amount of Use**. Maintenance of visual quality becomes more important as the level of use increases (see table below):

   -- high level of use.................High
   -- moderate level of use.................Moderate
   -- low level of use.................Low

   c. **Public Interest**. Maintenance of visual quality is:

   -- a major public issue.................High
   -- a moderate public issue.................Moderate
   -- a minor public issue.................Low

   d. **Adjacent Land Uses**. Maintenance of visual quality to sustain land use objectives of the land use at the KOP location:

   -- very important.................High
   -- moderately important.................Moderate
   -- slightly important.................Low

   e. **Special Area**. Maintenance of visual quality to sustain Special Area management objectives is:

   -- very important.................High
   -- moderately important.................Moderate
   -- slightly important.................Low

4. Determine the overall sensitivity level for each rating unit. This is a judgmental process which requires a careful analysis of all the above factors. Review the ratings given to each factor and analyze the relationship between factors. A high rating in any one factor does not necessarily mean that the overall sensitivity level rating should be high. For example, the rating for "type of users" might be high but the "amount of use" might be low. Consequently, the overall rating could be low or moderate.

5. Record the ratings and explanation on the sensitivity level rating sheet.

Table for Classifying Amount of Use			
Type Area	**High**	**Moderate**	**Low**
Roads and Highways	Greater then 45,000 visits/yr.	5,000-45,000 visits/yr.	Less than 5,000 visits/yr.
Rivers and Trails	Greater than 20,000 visits/yr.	2,000-20,000 visits/yr.	Less than 2,000 visits/yr.
Recreation Sites	Greater than 10,000 visitor days/yr.	2,000-10,000 visitor days/yr.	Less than 2,000 visitor days/yr.

Source: BLM Manual Handbook 8410-1, Visual Resource Inventory, January 1986.

Sensitivity Level Rating Sheet for Project Site

KOP	Sensitivity Factors							
	Scenic Quality Landscape Unit	Type of User	Amount of Use	Public Interests	Adjacent Land Uses	Special Areas	Overall Rating	Explanation
KOP No. 1: Coxcomb Mountains Trailhead	M-2	H	L	H	M	H	H	Within JTNP potential "Primi-tive Wilderness Area"
KOP No. 2: Eagle Mountains	M-1 & H-1	H	L	H	M	H	H	Within JTNP and near potential "Primitive Wilderness Area"
KOP No. 3: Pinto Basin	B-1	H	L	H	M	H	H	Within JTNP potential "Primi-tive Wilderness Area"
KOP No. 4: Coxcomb Mountains	M-2	H	L	H	M	H	H	Within JTNP potential "Primi-tive Wilderness Area"
KOP No. 5: Eagle Mountain Townsite	O-1	M	M	M	L	L	M	Residential Community
KOP No. 6: I-10/Desert Center	B-2	M	H	M	M	H	H	Eligible County Designated Scenic Highway; high use; residential area
KOP No. 7: Lake Tamarisk	B-2	M	H	M	M	L	M	Residential community
KOP No. 8: State Highway 177	B-2	M	H	M	L	L	M	High use road.

Notes: H = High.
M = Moderate.
L = Low.
See attached instruction sheet for definitions of sensitivity levels for each factor.

Visual Contrast Rating Worksheets

Visual Contrast Rating Worksheet KOP No. 1

(Coxcomb Mountains Trailhead)

KOP No. 1 Characteristic Natural Landscape Description			
	Landscape Features		
Elements	**1. Land/Water**	**2. Vegetation**	**3. Structures**
Form	Flat (basin) to steep, rugged complex terrain (mountains)	Low, flat	–
Line	Jagged, irregular silhouette, horizontal (basin)	Simple	–
Color	Tan brown and greens (basin); darker gray, brown and tan, mottled (mountains)	Tan/brown and greens	–
Texture	Medium to coarse grain, dense	Medium grain, even, sparse	–

KOP No. 1 Existing Site Description			
	Landscape Features		
Elements	**1. Land/Water**	**2. Vegetation**	**3. Structures**
Form	Rugged terrain, simple conical and low horizontal mounds.	–	–
Line	Jagged silhouette, horizontal and straight mounds	–	–
Color	Tan ,brown; darker gray, very light gray mounds	–	–
Texture	fine to coarse grain	–	–

KOP No. 1 Proposed Site Activity Description			
	Landscape Features		
Elements	**1. Land/Water**	**2. Vegetation**	**3. Structures**
Form	Pyramidal, simpler forms	–	–
Line	Angular, regular silhouette	–	–
Color	Tan brown, darker gray,	–	–
Texture	Smooth, uniform, fine grain	–	–

Visual Contrast Rating Worksheet KOP No. 1

(Coxcomb Mountains Trailhead)

KOP No. 1 Contrast Rating—Existing Conditions

Degree of Contrast (weight)	Features (Visual Contrast Rating)											
	Land/Water				Vegetation				Structures			
	Strong (3)	Moderate (2)	Weak (1)	None (0)	Strong (3)	Moderate (2)	Wea k (1)	None (0)	Strong (3)	Moderate (2)	Wea k (1)	None (0)
Elements												
Form (3)		✓					✓					✓
Line (2)		✓					✓					✓
Color (4)		✓					✓					✓
Texture (1)			✓				✓					✓
Total Contrast Score	19				10				0			
Source: BLM Manual Handbook 8431-1, Visual Resource Contrast Rating, January 1986.												

KOP No. 1 Contrast Rating—Proposed Project

Degree of Contrast (weight)	Features (Visual Contrast Rating)											
	Land/Water				Vegetation				Structures			
	Strong (3)	Moderate (2)	Weak (1)	None (0)	Strong (3)	Moderate (2)	Wea k (1)	None (0)	Strong (3)	Moderate (2)	Wea k (1)	None (0)
Elements												
Form (3)		✓					✓					✓
Line (2)		✓					✓					✓
Color (4)			✓				✓					✓
Texture (1)			✓				✓					✓
Total Contrast Score	15				10				0			
Source: BLM Manual Handbook 8431-1, Visual Resource Contrast Rating, January 1986.												

Visual Contrast Rating Worksheet KOP No. 2

(Eagle Mountains)

KOP No.2 Characteristic Natural Landscape Description			
	Landscape Features		
Elements	**1. Land/Water**	**2. Vegetation**	**3. Structures**
Form	Flat (basin) to steep, rugged complex terrain (mountains)	Low, flat	–
Line	Jagged, irregular silhouette, horizontal (basin)	Simple	–
Color	Tan brown and greens (basin); darker gray, brown and tan, mottled (mountains)	Tan/brown and greens	–
Texture	Medium to coarse grain, dense	Medium grain, even, sparse	–

KOP No. 2 Existing Site Description			
	Landscape Features		
Elements	**1. Land/Water**	**2. Vegetation**	**3. Structures**
Form	Prominent flat topped mounds, some rugged terrain west site	Low, flat	Low, indistinct
Line	Horizontal, regular to irregular	Simple	Horizontal
Color	Light gray to white, gray mauve	Green	Light tones/hues
Texture	Even fine grained, coarser to west	Very sparse	Even/random, fine grain

KOP No. 2 Proposed Activity Description-During Operation			
	Landscape Features		
Elements	**1. Land/Water**	**2. Vegetation**	**3. Structures**
Form	Complex, geometric and rugged	Low, flat	Low, indistinct
Line	Irregular, linear	Simple	Horizontal
Color	Medium gray, light gray	Green	Light tones/hues
Texture	Medium to coarse	Very sparse	Even/random, fine grain

KOP No. 2 Proposed Activity Description-After Closure			
	Landscape Features		
Elements	**1. Land/Water**	**2. Vegetation**	**3. Structures**
Form	Prominant, geometric, simple	Low, flat	Low, indistinct
Line	Flat, horizontal to angular	Simple	Horizontal
Color	Medium gray	Green	Light tones/hues
Texture	Fine grain, smooth	Very sparse	Even/random, fine grain

Visual Contrast Rating Worksheet KOP No. 2

(Eagle Mountains)

KOP No.2 Contrast Rating—Existing Conditions												
	Features (Visual Contrast Rating)											
	Land/Water				Vegetation				Structures			
Degree of Contrast (weight)	Strong (3)	Moderate (2)	Weak (1)	None (0)	Strong (3)	Moderate (2)	Wea k (1)	None (0)	Strong (3)	Moderate (2)	Wea k (1)	None (0)
Elements												
Form (3)		✓					✓				✓	
Line (2)		✓					✓				✓	
Color (4)	✓						✓				✓	
Texture (1)		✓					✓				✓	
Total Contrast Score	24				10				10			
Source: BLM Manual Handbook 8431-1, Visual Resource Contrast Rating, January 1986.												

KOP No.2 Contrast Rating—Proposed Project During Operation												
	Features (Visual Contrast Rating)											
	Land/Water				Vegetation				Structures			
Degree of Contrast (weight)	Strong (3)	Moderate (2)	Weak (1)	None (0)	Strong (3)	Moderate (2)	Wea k (1)	None (0)	Strong (3)	Moderate (2)	Wea k (1)	None (0)
Elements												
Form (3)		✓					✓				✓	
Line (2)		✓					✓				✓	
Color (4)		✓					✓				✓	
Texture (1)		✓					✓				✓	
Total Contrast Score	20				10				10			
Source: BLM Manual Handbook 8431-1, Visual Resource Contrast Rating, January 1986.												

Visual Contrast Rating Worksheet KOP No. 2

(Eagle Mountains)

KOP No.2 Contrast Rating—Proposed Project After Closure												
	Features (Visual Contrast Rating)											
	Land/Water				Vegetation				Structures			
Degree of Contrast (weight)	Strong (3)	Moderate (2)	Weak (1)	None (0)	Strong (3)	Moderate (2)	Wea k (1)	None (0)	Strong (3)	Moderate (2)	Wea k (1)	None (0)
Elements												
Form (3)	✓						✓				✓	
Line (2)	✓						✓				✓	
Color (4)		✓					✓				✓	
Texture (1)	✓						✓				✓	
Total Contrast Score	26				10				10			
Source: BLM Manual Handbook 8431-1, Visual Resource Contrast Rating, January 1986.												

Visual Contrast Rating Worksheet KOP No. 3

(Pinto Basin)

KOP No. 3 Characteristic Natural Landscape Description			
	Landscape Features		
Elements	**1. Land/Water**	**2. Vegetation**	**3. Structures**
Form	Flat (basin) to steep, rugged complex terrain (mountains)	Low, flat	–
Line	Jagged, irregular silhouette, horizontal (basin)	Simple	–
Color	Tan brown and greens (basin); darker gray, brown and tan, mottled (mountains)	Tan/brown and greens	–
Texture	Medium to coarse grain, dense	Medium grain, even, sparse	–

KOP No. 3 Existing Site Description			
	Landscape Features		
Elements	**1. Land/Water**	**2. Vegetation**	**3. Structures**
Form	Flat to steep, rugged, complex	–	–
Line	Rugged silhouette, irregular	–	–
Color	Gray, brown, light gray	–	–
Texture	Medium to coarse grain, dense	–	–

KOP No. 3 Proposed Activity Description			
	Landscape Features		
Elements	**1. Land/Water**	**2. Vegetation**	**3. Structures**
Form	Somewhat pyrimidal, simpler	–	–
Line	Angular, regular	–	–
Color	Gray	–	–
Texture	Uniform, fine grain	–	–

Visual Contrast Rating Worksheet KOP No. 3

(Pinto Basin)

KOP No. 3 Contrast Rating—Existing Conditions												
	Features (Visual Contrast Rating)											
	Land/Water				Vegetation				Structures			
Degree of Contrast (weight)	Strong (3)	Moderate (2)	Weak (1)	None (0)	Strong (3)	Moderate (2)	Wea k (1)	None (0)	Strong (3)	Moderate (2)	Wea k (1)	None (0)
Elements												
Form (3)			✓				✓					✓
Line (2)			✓				✓					✓
Color (4)		✓					✓					✓
Texture (1)			✓				✓					✓
Total Contrast Score	14				10				0			
Source: BLM Manual Handbook 8431-1, Visual Resource Contrast Rating, January 1986.												

KOP No. 3 Contrast Rating—Proposed Project												
	Features (Visual Contrast Rating)											
	Land/Water				Vegetation				Structures			
Degree of Contrast (weight)	Strong (3)	Moderate (2)	Weak (1)	None (0)	Strong (3)	Moderate (2)	Wea k (1)	None (0)	Strong (3)	Moderate (2)	Wea k (1)	None (0)
Elements												
Form (3)		✓					✓					✓
Line (2)		✓					✓					✓
Color (4)			✓				✓					✓
Texture (1)		✓					✓					✓
Total Contrast Score	16				10				0			
Source: BLM Manual Handbook 8431-1, Visual Resource Contrast Rating, January 1986.												

Visual Contrast Rating Worksheet KOP No. 4

(Coxcomb Mountains)

KOP No. 4 Characteristic Natural Landscape Description			
	Landscape Features		
Elements	**1. Land/Water**	**2. Vegetation**	**3. Structures**
Form	Flat (basin) to steep, rugged complex terrain (mountains)	Low, flat	–
Line	Jagged, irregular silhouette, horizontal (basin)	Simple	–
Color	Tan brown and greens (basin); darker gray, brown and tan, mottled (mountains)	Tan/brown and greens	–
Texture	Medium to coarse grain, dense	Medium grain, even, sparse	–

KOP No. 4 Existing Site Description			
	Landscape Features		
Elements	**1. Land/Water**	**2. Vegetation**	**3. Structures**
Form	Rugged complex terrain	–	–
Line	Jagged, irregular silhouette,	–	–
Color	Dark gray and brown	–	–
Texture	Medium to coarse grain, dense	–	–

KOP No. 4 Proposed Activity Description			
	Landscape Features		
Elements	**1. Land/Water**	**2. Vegetation**	**3. Structures**
Form	Complex	–	–
Line	Angular straight	–	–
Color	Dark gray	–	–
Texture	Medium	–	–

Visual Contrast Rating Worksheet KOP No. 4

(Coxcomb Mountains)

KOP No.4 Contrast Rating—Existing Conditions												
	Features (Visual Contrast Rating)											
	Land/Water				Vegetation				Structures			
Degree of Contrast (weight)	Strong (3)	Moderate (2)	Weak (1)	None (0)	Strong (3)	Moderate (2)	Wea k (1)	None (0)	Strong (3)	Moderate (2)	Wea k (1)	None (0)
Elements												
Form (3)				✓				✓				✓
Line (2)				✓				✓				✓
Color (4)				✓				✓				✓
Texture (1)				✓				✓				✓
Total Contrast Score	0				0				0			
Source: BLM Manual Handbook 8431-1, Visual Resource Contrast Rating, January 1986.												

KOP No.4 Contrast Rating—Proposed Project												
	Features (Visual Contrast Rating)											
	Land/Water				Vegetation				Structures			
Degree of Contrast (weight)	Strong (3)	Moderate (2)	Weak (1)	None (0)	Strong (3)	Moderate (2)	Wea k (1)	None (0)	Strong (3)	Moderate (2)	Wea k (1)	None (0)
Elements												
Form (3)			✓					✓				✓
Line (2)			✓					✓				✓
Color (4)				✓				✓				✓
Texture (1)				✓				✓				✓
Total Contrast Score	5				0				0			
Source: BLM Manual Handbook 8431-1, Visual Resource Contrast Rating, January 1986.												

Visual Contrast Rating Worksheet KOP No. 5

(Eagle Mountain Townsite)

KOP No. 5 Characteristic Natural Landscape Description			
	Landscape Features		
Elements	**1. Land/Water**	**2. Vegetation**	**3. Structures**
Form	Flat (basin) to steep, rugged complex terrain (mountains)	Low, flat	–
Line	Jagged, irregular silhouette, horizontal (basin)	Simple	–
Color	Tan brown and greens (basin); darker gray, brown and tan, mottled (mountains)	Tan/brown and greens	–
Texture	Medium to coarse grain, dense	Medium grain, even, sparse	–

KOP No. 5 Existing Site Description			
	Landscape Features		
Elements	**1. Land/Water**	**2. Vegetation**	**3. Structures**
Form	Terracing with angular hummocks or mounds, complex	Low, flat	Regular, simple box shapes; tall, narrow poles
Line	Diagonal and horizontal (terraces), linear and irregular	Simple, weak	Tall, vertical, thin
Color	Light gray to white, reddish brown, tan gray	Light to medium greens, red	Light to medium hues (white, yellow, brown)
Texture	Medium grain, mottled texture	Medium grain, sparse	Medium density, even/ordered

KOP No. 5 Proposed Activity Description-During Operation			
	Landscape Features		
Elements	**1. Land/Water**	**2. Vegetation**	**3. Structures**
Form	Dominant, simple, regular, terracing with hummocks	Low, flat	Regular, simple box shapes; tall, narrow poles
Line	Smooth, simple, horizontal and diagonal	Simple	Tall, vertical, thin
Color	Gray, light gray	Tan/brown and greens	Light to medium hues (white, yellow, brown)
Texture	Smooth, uniform, fine grain	Even	Medium density, even/ordered

KOP No. 5 Proposed Activity Description-After Closure			
	Landscape Features		
Elements	**1. Land/Water**	**2. Vegetation**	**3. Structures**
Form	Dominant, simple, regular	Low, flat	Regular, simple box shapes; tall, narrow poles
Line	Smooth, simple, horizontal and diagonal	Simple	Tall, vertical, thin

Color	Gray	Tan/brown and greens	Light to medium hues (white, yellow, brown)
Texture	Smooth, uniform, fine grain	Even	Medium density, even/ordered

Visual Contrast Rating Worksheet KOP No. 5

(Eagle Mountain Townsite)

KOP No. 5 Contrast Rating—Existing Conditions

Degree of Contrast (weight)	Land/Water Strong (3)	Land/Water Moderate (2)	Land/Water Weak (1)	Land/Water None (0)	Vegetation Strong (3)	Vegetation Moderate (2)	Vegetation Weak (1)	Vegetation None (0)	Structures Strong (3)	Structures Moderate (2)	Structures Weak (1)	Structures None (0)
Elements												
Form (3)		✓					✓		✓			
Line (2)		✓					✓		✓			
Color (4)	✓						✓		✓			
Texture (1)			✓				✓		✓			
Total Contrast Score	23				10				30			

Features (Visual Contrast Rating)

Source: BLM Manual Handbook 8431-1, Visual Resource Contrast Rating, January 1986.

KOP No. 5 Contrast Rating—Proposed Project During Operation

Degree of Contrast (weight)	Land/Water Strong (3)	Land/Water Moderate (2)	Land/Water Weak (1)	Land/Water None (0)	Vegetation Strong (3)	Vegetation Moderate (2)	Vegetation Weak (1)	Vegetation None (0)	Structures Strong (3)	Structures Moderate (2)	Structures Weak (1)	Structures None (0)
Elements												
Form (3)		✓					✓					✓
Line (2)		✓					✓					✓
Color (4)	✓						✓					✓
Texture (1)			✓				✓					✓
Total Contrast Score	23				10				0			

Features (Visual Contrast Rating)

Source: BLM Manual Handbook 8431-1, Visual Resource Contrast Rating, January 1986.

Visual Contrast Rating Worksheet KOP No. 5

(Eagle Mountain Townsite)

KOP No. 5 Contrast Rating—Proposed Project After Closure												
Degree of Contrast (weight)	**Features (Visual Contrast Rating)**											
	Land/Water				**Vegetation**				**Structures**			
	Strong (3)	**Moderate (2)**	**Weak (1)**	**None (0)**	**Strong (3)**	**Moderate (2)**	**Wea k (1)**	**None (0)**	**Strong (3)**	**Moderate (2)**	**Wea k (1)**	**None (0)**
Elements												
Form (3)	✓						✓					✓
Line (2)	✓						✓					✓
Color (4)		✓					✓					✓
Texture (1)	✓						✓					✓
Total Contrast Score		26				10				0		
Source: BLM Manual Handbook 8431-1, Visual Resource Contrast Rating, January 1986.												

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Visual Contrast Rating Worksheet KOP No. 6

(I-10 at Desert Center)

KOP No. 6 Characteristic Natural Landscape Description			
	Landscape Features		
Elements	**1. Land/Water**	**2. Vegetation**	**3. Structures**
Form	Flat (basin) to steep, rugged complex terrain (mountains)	Low, flat	–
Line	Jagged, irregular silhouette, horizontal (basin)	Simple	–
Color	Tan brown and greens (basin); darker gray, brown and tan, mottled (mountains)	Tan/brown and greens	–
Texture	Medium to coarse grain, dense	Medium grain, even, sparse	–

KOP No. 6 Existing Site Description			
	Landscape Features		
Elements	**1. Land/Water**	**2. Vegetation**	**3. Structures**
Form	Rugged complex terrain	–	–
Line	Jagged, irregular silhouette	–	–
Color	Gray, reddish brown, light gray	–	–
Texture	Medium to coarse grain, dense	–	–

KOP No. 6 Proposed Activity Description			
	Landscape Features		
Elements	**1. Land/Water**	**2. Vegetation**	**3. Structures**
Form	Angular, simple	–	–
Line	Horizontal, diagonal, straight	–	–
Color	Gray	–	–
Texture	Uniform, fine grain	–	–

Visual Contrast Rating Worksheet KOP No. 6

(I-10 at Desert Center)

KOP No. 6 Contrast Rating—Existing Conditions												
	Features (Visual Contrast Rating)											
	Land/Water				Vegetation				Structures			
Degree of Contrast (weight)	Strong (3)	Moderate (2)	Weak (1)	None (0)	Strong (3)	Moderate (2)	Weak (1)	None (0)	Strong (3)	Moderate (2)	Weak (1)	None (0)
Elements												
Form (3)				✓				✓				✓
Line (2)				✓				✓				✓
Color (4)	✓							✓				✓
Texture (1)				✓				✓				✓
Total Contrast Score	12				0				0			
Source: BLM Manual Handbook 8431-1, Visual Resource Contrast Rating, January 1986.												

KOP No. 6 Contrast Rating—Proposed Project												
	Features (Visual Contrast Rating)											
	Land/Water				Vegetation				Structures			
Degree of Contrast (weight)	Strong (3)	Moderate (2)	Weak (1)	None (0)	Strong (3)	Moderate (2)	Weak (1)	None (0)	Strong (3)	Moderate (2)	Weak (1)	None (0)
Elements												
Form (3)		✓						✓				✓
Line (2)		✓						✓				✓
Color (4)			✓					✓				✓
Texture (1)			✓					✓				✓
Total Contrast Score	15				0				0			
Source: BLM Manual Handbook 8431-1, Visual Resource Contrast Rating, January 1986.												

Visual Contrast Rating Worksheet KOP No. 7

(Highway 177/Lake Tamarisk)

KOP No. 7 Characteristic Natural Landscape Description			
	Landscape Features		
Elements	**1. Land/Water**	**2. Vegetation**	**3. Structures**
Form	Flat (basin) to steep, rugged complex terrain (mountains)	Low, flat	–
Line	Jagged, irregular silhouette, horizontal (basin)	Simple	–
Color	Tan brown and greens (basin); darker gray, brown and tan, mottled (mountains)	Tan/brown and greens	–
Texture	Medium to coarse grain, dense	Medium grain, even, sparse	–

KOP No. 7 Existing Site Description			
	Landscape Features		
Elements	**1. Land/Water**	**2. Vegetation**	**3. Structures**
Form	Rugged complex terrain, low mound	–	–
Line	Jagged, irregular silhouette, horizontal mound	–	–
Color	Gray, light gray	–	–
Texture	Medium to coarse grain, dense	–	–

KOP No. 7 Proposed Activity Description			
	Landscape Features		
Elements	**1. Land/Water**	**2. Vegetation**	**3. Structures**
Form	Angular, simple	–	–
Line	Horizontal, diagonal, straight	–	–
Color	Gray	–	–
Texture	Uniform, fine grain	–	–

Visual Contrast Rating Worksheet KOP No. 7

(Highway 177/Lake Tamarisk)

KOP No. 7 Contrast Rating—Existing Conditions												
Degree of Contrast (weight)	Features (Visual Contrast Rating)											
	Land/Water				Vegetation				Structures			
	Strong (3)	Moderate (2)	Weak (1)	None (0)	Strong (3)	Moderate (2)	Wea k (1)	None (0)	Strong (3)	Moderate (2)	Wea k (1)	None (0)
Elements												
Form (3)			✓					✓				✓
Line (2)			✓					✓				✓
Color (4)		✓						✓				✓
Texture (1)			✓					✓				✓
Total Contrast Score	14				0				0			
Source: BLM Manual Handbook 8431-1, Visual Resource Contrast Rating, January 1986.												

KOP No. 7 Contrast Rating—Proposed Project												
Degree of Contrast (weight)	Features (Visual Contrast Rating)											
	Land/Water				Vegetation				Structures			
	Strong (3)	Moderate (2)	Weak (1)	None (0)	Strong (3)	Moderate (2)	Wea k (1)	None (0)	Strong (3)	Moderate (2)	Wea k (1)	None (0)
Elements												
Form (3)		✓						✓				✓
Line (2)		✓						✓				✓
Color (4)			✓					✓				✓
Texture (1)			✓					✓				✓
Total Contrast Score	15				0				0			
Source: BLM Manual Handbook 8431-1, Visual Resource Contrast Rating, January 1986.												

Visual Contrast Rating Worksheet KOP No. 8

(Highway 177/Chuckwalla Valley)

KOP No. 8 Characteristic Natural Landscape Description			
	Landscape Features		
Elements	**1. Land/Water**	**2. Vegetation**	**3. Structures**
Form	Flat (basin) to steep, rugged complex terrain (mountains)	Low, flat	–
Line	Jagged, irregular silhouette, horizontal (basin)	Simple	–
Color	Tan brown and greens (basin); darker gray, brown and tan, mottled (mountains)	Tan/brown and greens	–
Texture	Medium to coarse grain, dense	Medium grain, even, sparse	–

KOP No. 8 Existing Site Description			
	Landscape Features		
Elements	**1. Land/Water**	**2. Vegetation**	**3. Structures**
Form	Complex, rugged, low horizontal mound	–	–
Line	Jagged silhouette, horizontal mound	–	–
Color	Dark gray, light gray	–	–
Texture	Fine to coarse grain	–	–

KOP No. 8 Proposed Activity Description			
	Landscape Features		
Elements	**1. Land/Water**	**2. Vegetation**	**3. Structures**
Form	Amgular, simpler	–	–
Line	Diagonal, straight	–	–
Color	Gray	–	–
Texture	Uniform, fine grain	–	–

Visual Contrast Rating Worksheet KOP No. 8

(Highway 177/Chuckwalla Valley)

KOP No. 8 Contrast Rating—Existing Conditions												
	Features (Visual Contrast Rating)											
	Land/Water				Vegetation				Structures			
Degree of Contrast (weight)	Strong (3)	Moderate (2)	Weak (1)	None (0)	Strong (3)	Moderate (2)	Wea k (1)	None (0)	Strong (3)	Moderate (2)	Wea k (1)	None (0)
Elements												
Form (3)			✓					✓				✓
Line (2)			✓					✓				✓
Color (4)		✓						✓				✓
Texture (1)			✓					✓				✓
Total Contrast Score	14				0				0			
Source: BLM Manual Handbook 8431-1, Visual Resource Contrast Rating, January 1986.												

KOP No. 8 Contrast Rating—Proposed Project												
	Features (Visual Contrast Rating)											
	Land/Water				Vegetation				Structures			
Degree of Contrast (weight)	Strong (3)	Moderate (2)	Weak (1)	None (0)	Strong (3)	Moderate (2)	Wea k (1)	None (0)	Strong (3)	Moderate (2)	Wea k (1)	None (0)
Elements												
Form (3)		✓						✓				✓
Line (2)		✓						✓				✓
Color (4)			✓					✓				✓
Texture (1)			✓					✓				✓
Total Contrast Score	15				0				0			
Source: BLM Manual Handbook 8431-1, Visual Resource Contrast Rating, January 1986.												

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Appendix J
Noise Analysis Methodology

Appendix J
Noise Analysis Methodology

Eagle Mountain Landfill and Recycling Center
Environmental Impact Statement/Environmental Impact Report

This memorandum describes the methodology used to perform the Eagle Mountain Landfill EIR noise analysis. The discussion is divided into two areas: Noise Measurement Procedures and Noise Prediction Procedures.

Noise Measurement Procedures

Noise level monitoring was performed at 16 locations in and around the Project vicinity to establish existing conditions and to verify noise models used in the analysis. The sites were monitored using a Bruel & Kjaer 2236 Type 1 sound level meter. Fifteen to thirty-minute measurements were performed during the daytime, evening, and nighttime periods at each site between June 5 and June 9, 1995. Photographs of microphone placement were taken at each site. Traffic counts, broken down into vehicle classes, were recorded concurrently with noise measurements whenever possible in order to facilitate model verification. Measurement procedures complied with the American National Standards Institute (ANSI) S1.13-1971 and *Sound Procedures for Measuring Noise* by FHWA (August 1981).

Supplemental noise level monitoring was performed at one location in the residential area nearest the main line track in Palm Desert, California. Two 30-minute noise monitoring sessions were performed at 2:00 p.m. and 9:30 p.m. on January 4, 1996.

Noise Prediction Procedures

Traffic Noise. Traffic noise levels were modeled using the Federal Highway Administration (FHWA) Highway Noise Prediction Model as coded in the computer model described in the *Noise Barrier Cost Reduction Procedure STAMINA 2.0/OPTIMA User's Manual* (1982) developed for FHWA. STAMINA uses data on traffic volumes, vehicle mix, speed, vehicle noise emission levels, and roadway geometry to predict traffic-generated noise levels at chosen receptors.

Traffic which was counted during monitoring was used in the STAMINA model to verify the STAMINA results with the measured noise levels. Measured and modeled noise levels agreed within 3 dBA at the monitoring locations where traffic was the dominant noise source. Differences in noise levels of less than 3 dBA are considered imperceptible.

Existing and future noise levels were predicted using the verified STAMINA computer model. Traffic information used in the STAMINA model included traffic volume and speed data generated by DKS Associates.

Rail Noise. The rail noise analysis was prepared to meet the requirements of the Federal Transit Authority (FTA) *UMTA Circular 5620.1*. Existing and future noise levels were predicted using the 21-step procedure as outlined in the Wyle Laboratories Report (WCR 73-5, *Assessment of Noise Environments Around Railroad Operations*, July 1973). The output of the detailed modeling procedure will be stated in terms of the 24-hour Community Noise Equivalent Level (CNEL). Information used for the calculations of the mainline existing and future noise levels were obtained from Southern Pacific Corporate Safety Director, Jim P. Bearden. Information used for the calculations of the Eagle Mountain Railroad future noise levels was obtained from Mine Reclamation Corporation Information used in the analysis includes average daily train traffic, length of train, speed, and a breakdown of daytime, evening and nighttime train traffic.

Stationary Source Noise. Stationary source noise levels included landfill and construction activities. Information of the type of equipment to be used for operations was provided by Mine Reclamation Corporation or was based on similar operations. Equipment noise levels information was based on the U.S. Environmental Protection Agency document *Noise from Construction Equipment and Operations, Building Equipment, and Home Appliances* (1971), information from the Caterpillar Tractor Company, or field measurements of similar equipment. Noise levels at each receiver was predicted using a standard distance attenuation formula. Noise levels decrease with distance from a source. In general, noise levels will decrease by approximately 6 dBA for every doubling of distance. The decrease is due to sound waves spreading out (geometric divergence) as they travel away from the noise source. Topography, vegetation, and atmospheric conditions also tend to reduce noise levels at locations remote from the source. None of these noise reducing effects were included in this conservative estimate.

Appendix K
Updated Cultural Resources Survey

- K-1 Cultural Resource Investigation, Eagle Mountain Townsite
- K-2 Cultural Resource Survey of the Eagle Mountain Mine and the Kaiser Industrial Railroad
- K-3 An Assessment of the Potential National Register Eligibility of the Eagle Mountain Mine

Appendix K-1
Cultural Resource Investigation,
Eagle Mountain Townsite

Cultural Resource Investigation
Eagle Mountain Townsite

Submitted to:
Mr. Tom Peters
CH2M Hill
2510 Red Hill Ave,
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Prepared by;
James J. Schmidt
August 1995

Greenwood and Associates
725 Jacon Way
Pacific Palisades, CA 90272

ABSTRACT

At the request of CH2M Hill, Greenwood and Associates has conducted a Class III cultural resource inventory for Kaiser Resources Incorporated (Kaiser) of the company owned Eagle Mountain Townsite. The townsite consists of a former mining community designed to supply housing for Kaiser employees and their families, that occupies some 404 acres in eastern Riverside County, California.

This study was prepared in order to identify any cultural resources within the townsite area, and provide an informed opinion regarding the potential significance of archaeological resources identified in accordance with the National Historic Preservation Act (NHPA) of 1966, Section 106, and California Environmental Quality Act (CEQA) guidelines. The investigation was conducted under Permit No. CA-94-01-16, United States Department of the Interior, Bureau of Land Management.

As part of this investigation a review of available archaeological site archives, historical maps, and documents concerning the proposed project area was accomplished, and a pedestrian surface examination conducted. One isolated artifact of apparent prehistoric origin was recorded, and an inventory of townsite structures accomplished in the course of the field examination. Of these, none is considered as eligible to the National Register of Historic Places, or important as defined by CEQA.

This report describes the results of the background research, methods and results of the field investigation, and conclusions regarding the probability of impacts by reason of project related activities.

CONTENTS

Figures

INTRODUCTION

At the request of Ch2M Hill, Greenwood and Associates has conducted a Class III cultural resource inventory for Kaiser Resources Incorporated (Kaiser) of the company owned Eagle Mountain Townsite. The townsite consists of a former mining community designed to supply housing for Kaiser employees and their families, that occupies some 404 acres in eastern Riverside County, California (Figure 1).

This study was prepared in order to identify any cultural resources within the townsite area, and provide an informed opinion regarding the potential significance of archaeological resources identified in accordance with the National Historic Preservation Act (NHPA) of 1966, Section 106, and California Environmental Quality Act (CEQA) guidelines. The investigation was conducted under Permit No. CA-94-01-16, United States Department of the Interior, Bureau of Land Management.

As part of this investigation a review of available archaeological site archives, historical maps, and documents concerning the proposed project area was accomplished August 21, 1995, by James J. Schmidt, at the Eastern Information Center, Department of Anthropology, University of California, Riverside.

Project related field efforts consisted of an intensive surface reconnaissance of the proposed townsite redevelopment area. The field reconnaissance was conducted between August 22 and 25, 1995, by James J. Schmidt and Douglas McIntosh. This report describes the results of the background research, methods and results of the field investigation, and conclusions regarding the probability of impacts to cultural locations by reason of project related activities.

LOCATION AND NATURE OF THE PROPOSED PROJECT

The community of Eagle Mountain is in eastern Riverside County, California. The townsite is situated along the eastern slope of the Eagle Mountain Range, approximately 11 miles north of Desert Center, California, and occupies portions of Sections 1 and 2 of Township 4 South, Range 14 East, of the USGS Victory Pass 7.5' quadrangle (Figure 2).

The townsite is represented as an existing former mining community that is now partially occupied by Kaiser employees and tenants. Kaiser has filed a request to redevelop the now partially abandoned townsite in concert with their efforts to rehabilitate the property and the adjacent Eagle Mountain open-pit iron-ore mine. Pursuant to these efforts approximately 404 acres have been designated as within the townsite redevelopment area and subdivided, according to

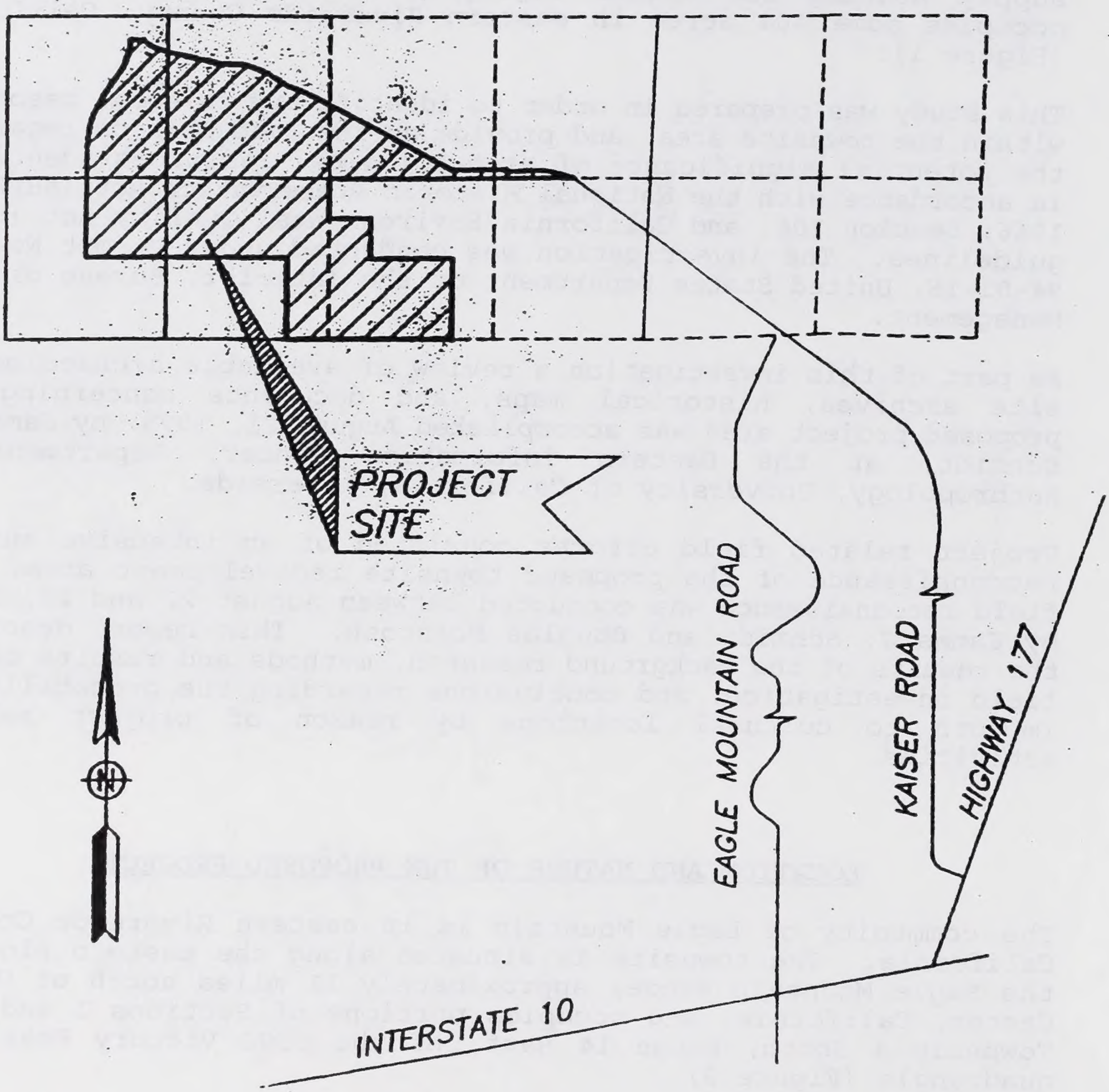

Figure 1
Project Vicinity Map

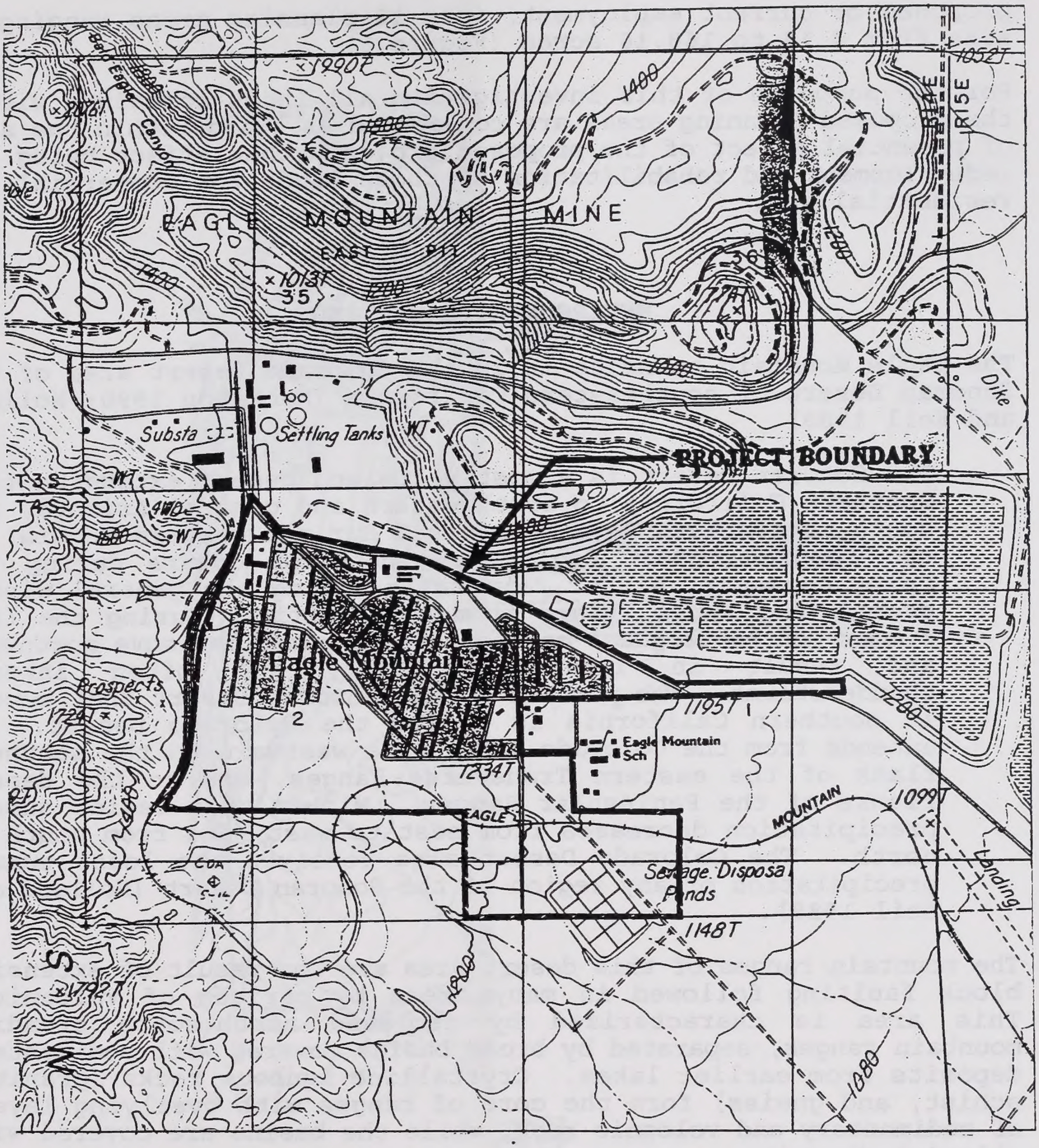

Figure 2
Eagle Mountain Townsite Project Location Map
Source: USGS 7.5' Victory Pass Quadrangle
Scale 1:24,000

proposed or current employment, into 12 planning areas ranging in size from 4.18 to 168.16 acres (Figure 3).

For the purposes of this investigation all lands contained within the proposed planning areas are considered as lying within the area of potential effect of the proposed project; that effect being the redevelopment and rehabilitation of those lands for commercial and residential use.

ENVIRONMENTAL SETTING

The Eagle Mountain townsite is in the Colorado Desert area of the Sonoran Desert of southeastern California (MacMahon 1990; Holland and Keil 1989).

> The Sonoran Desert is a mostly lowland desert extending from Southern California to southwestern and central Arizona, and south to southern Baja California Sur and western Sonora. In the Sonoran Desert Region precipitation occurs during two rainy seasons. Winter rain falls during the general winter storms that sweep inland from the Pacific. During the late summer months tropical monsoon storms sometimes move northward and result in localized, brief, and often intense thunderstorms. The portion of the Sonoran Desert that occurs in southern California is called the Colorado Desert. It extends from the Colorado River area westward to the southern flank of the eastern Transverse Ranges, and to the desert flanks of the Peninsular Ranges. Within this region summer precipitation decreases from east to west, and from south to north. The Colorado Desert area receives the least summer precipitation of any region of the Sonoran Desert [Holland and Keil 1989].

The mountain ranges of this desert area are the result of extensive block faulting followed in many areas by periods of vulcanism. This area is characterized by isolated north-south trending mountain ranges, separated by broad basins covered with sedimentary deposits from earlier lakes. Crystalline igneous rocks (granite, schist, and gneiss) form the core of ranges with overlying layers of sedimentary and volcanic rock, while the basins are covered with alluvial deposits.

The biotic setting of the project area has been described as the Sonoran Floristic Province (Holland and Keil 1989; Jaeger 1969). This province extends from the east side of the southern Sierra Nevada, Transverse, and Peninsular Ranges east and south to southern Nevada, Arizona and northwestern Mexico, and includes the Mojave and Colorado Desert regions (Holland and Keil 1989). Plant communities represented within this province include both Desert woodland and Desert scrub communities with distributions largely

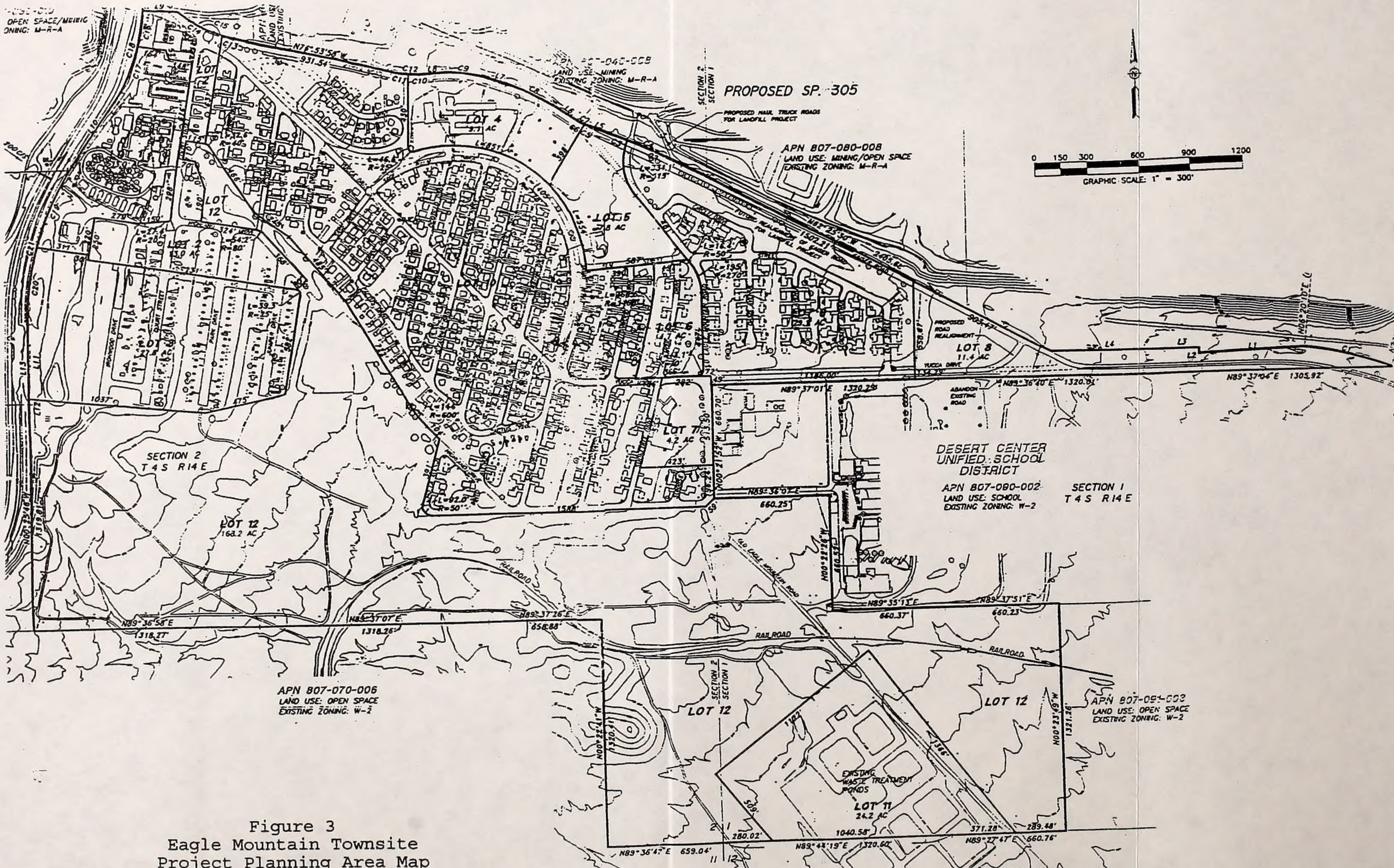

Figure 3
Eagle Mountain Townsite
Project Planning Area Map

dependent on factors of soil type, soil moisture, annual precipitation, and elevation.

Within the project area introduced grasses and forbs predominate among the represented plant species; however, two native plant communities were identified in the course of this investigation and are briefly described below. Represented were Creosote bush scrub and Desert dry wash communities. These were found to occur primarily in the southern reaches of the project area, and were represented as mixed and pure stands, with distributions often dictated by the degree and nature of associated surface disturbance.

Creosote bush scrub

Creosote bush scrub communities occur over extensive desert areas in southeastern California (Holland and Keil 1989). While *Larrea tridentata* (creosote bush) is the dominant plant within the community, the associated species can vary greatly dependent largely on the diversity of microhabitats represented. Species often associated with Creosote bush scrub in the Colorado Desert region include *Eriogonum inflatum* (bladderstem), *Opuntia basilaris* (beavertail cactus), *Opuntia bigelovii* (teddybear cholla), and species of *Lycium* (wolfberry).

Desert Dry Wash

Desert Dry Wash communities develop along wash channels that are deep enough to have some subsurface water retention or flow. Dry wash communities have been characterized as a mixture of shrubs from surrounding desert scrub communities and shrubs and trees requiring greater moisture than that available away from the washes (Holland and Keil 1989).

In the vicinity of the Eagle Mountain townsite the Desert dry wash community appeared largely confined to mechanically created drainage ditches surrounding the development and to the more deeply eroded landforms within the open space area (Planning Area 12) forming the southern project boundary. Plant species common to this community include *Acacia greggii* (catclaw acacia), *Cercidium floridum* (palo verde), *Hymenoclea salsola* (burrobrush), and *Lycium andersonii* (wolfberry).

ETHNOGRAPHIC BACKGROUND

This section summarizes the prehistoric regional and cultural history of the project area. The discussion has been limited to that Native American group, or groups, described as occupying the project area at the time of European contact and the historically documented activities following that contact. A more detailed

description of time frames and theories surrounding the formation, establishment, organization, and cultural or physical affinities of earlier populations can be found in Moratto (1984), Warren and Crabtree (1986), and Bull et al. (1991).

Cultural sequences described for the study area extend from 12,000 years before present (BP) to the time of historic contact with European peoples, and include evidence of incursions by Puebloan populations in organized pursuit of valued raw materials. These have been defined on the basis of specific tool types, materials, and represented assemblages, and suggest some cultural continuity to approximately 1200 BP. The sequence described by Warren and Crabtree (1986) in essence suggests that environmental change encouraged human adaptation. Changes in available flora and fauna resulted in a concomitant change in subsistence strategy that is represented in the associated tool kit, and encouraged a widening of the economic base via the expansion of trade networks.

Archaeological evidence suggests that beginning approximately 1200 years ago, and continuing to the time of European contact, members of a larger affiliation, speaking similar languages, known as the Shoshoneans, occupied the study area. The Shoshonean period is characterized by the occurrence of distinctive projectile points and crude brownware pottery (Warren and Crabtree 1986). Assemblages including these artifacts have been noted throughout the northern Mojave and have been considered indicative of the expansion of Shoshonean groups into much of the California desert. The Native American peoples ethnographically described as utilizing the study area since the time of European contact include the Serrano, Cahuilla, and the Chemehuevi (Kroeber 1953; Kelly and Fowler 1986; Bull et al. 1991); all are of Shoshonean stock.

The Shoshoneans form a broad band of peoples, speaking variants of Uto-Aztekan languages, that extend from the mountains of Idaho and Montana south into Panama (Kroeber 1953). Kroeber describes four Shoshonean groups of languages within California, with the most extensive of these, the Great Basin or Plateau Branch (Numic), spoken within the study area by the Chemehuevi, and respective divisions of the California Branch (Takic) spoken by the Serrano and Cahuilla.

Moving west from the Great Basin area into the Mojave Desert, and subsequently through the San Gabriel and San Bernardino Mountain passes onto the coastal plains, Shoshonean groups are believed to have been well established in southern California, a minimum of 1200 to 1500 years ago, and may have arrived as early as 3000 years ago (Bean and Smith 1978; Kroeber 1953; Moratto 1984). Resident coastal and inland populations were apparently displaced to the north and south with the Shosoneans forming a "wedge" between the linguistically similar, Hokan speaking, Chumashan and Yuman peoples.

Shoshonean peoples once occupied a broad strip of territory extending across southern Utah and Nevada, and following the right bank of the Colorado River south into California (Kelly and Fowler 1986). This landmass touches upon a variety of environmental zones and is capable of sustaining aboriginal populations to varying degrees dependant largely on the availability of water. Rainfall and topography vary widely within the area and had a direct effect upon the resource base available to aboriginal populations.

These desert groups practiced a hunting and gathering subsistence strategy that focused largely on the procurement of seasonally available foodstuffs. Floodplain farming was practiced by some groups, in the form of small gardens, where feasible (Kelly and Fowler 1986). Settlement size, location, and degree of mobilization varied greatly according to environmental influences.

Settlement was mobile and scattered, but with recurrent residence in at least one fixed area. Houses have been described as closely grouped, with the occupants usually related by blood or marriage. Village size varied from one or two households to a maximum reported number of 20. Larger, more sedentary village sites occurred where water sources were more dependable and the animal and plant resource base more extensive. Those within the confines of the lower desert areas were smaller, perhaps numbering less than 20 individuals, and by necessity more mobile. All groups stored as much food as possible against the winter and recurrent spring famine (Kelly and Fowler 1986).

Resources exploited within the desert environment varied with the locality of the settlement but included a wide range of available plant and animal species. Primary vegetable staples included cactus fruit, mesquite beans, yucca root, tule bulb, and various seeds, while animal species present included mountain sheep, antelope, small game such as rabbits and other rodents, birds and lizards (Kelly and Fowler 1986; Kroeber 1953).

HISTORICAL BACKGROUND

The project area, like most of the rest of California's vast desert domain, has experienced little human alteration in the course of recorded history. Beginning in 1976, the BLM has sponsored a series of extensive cultural resource studies of the Mojave and Colorado Deserts in connection with the creation of the California Desert Conservation Area (see, for example, BLM 1977; Gallegos et al. 1980; Warren et al. 1981). Combined, these studies offer a fairly thorough overview of the history of California's desert territory. This study, therefore, will focus more specifically on the immediate project area.

For many centuries, a number of Native American groups have made their homes in the Mojave and Colorado Deserts, sparsely populating the area in small groups (BLM 1977:2:36; Schuiling 1984:21). Yet to the early Spanish, Mexican, and Euroamerican travellers passing through the area, the harsh environment of the desert held very little appeal. In the words of Lieutenant Joseph C. Ives, one of the first Euroamericans to cross the desert in southeastern California, "this region...is, of course, altogether valueless. After entering it there is nothing to do but leave" (Schad 1988:1). The evolution of trails, wagon roads, and eventually railroads and highways, has consequently emerged through the decades as one of the main themes of recorded history of the region, to be complemented later by other themes such as mining and prospecting.

To most of the Spaniards, Mexicans and Euroamericans travelling or settling in California in the early years, the Mojave and Colorado Deserts represented nothing but an enormous obstacle enroute between the coastal settlements of Southern California and their homelands in Mexico or the Eastern United States. The earliest recorded endeavors in these deserts, accordingly, were to find the easiest and fastest routes available to overcome this obstacle.

Of the most important desert trails established during the Spanish and Mexican years, two came within a few dozen miles of the project area: the Mojave Trail to the north, and the Cocomaricopa Trail to the South. Both trails had probably been travelled by Native Americans for centuries before the advent of the white man, and their subsequent "discovery" by European explorers dates to the late eighteenth and early nineteenth centuries.

The Mojave Trail, whose course roughly paralleled that of present day Interstate 40 but a few miles to the north, was "discovered" in 1776 when a group of Mojave Indians guided Father Francisco Garcés from the vicinity of present-day Needles to the Cajon Pass (Schuiling 1984:24). Later, in the 1860s, the Mojave Trail became a military artery for U.S. government wagons transporting tens of thousands of soldiers along with their equipment, supplies, and camp followers into southern California. This provided the trail's other name, the Old Government Road (Casebier 1988:79; Robinson 1958:36).

Almost half a century after the discovery of the Mojave Trail, Spanish authorities in Alta California were informed of the Cocomaricopa Trail by a group of Cocomaricopa Indians in 1821 (Bull et al. 1991; Warren et al. 1981:85). Its course approximated today's Interstate 10, the busiest highway in the nation, but for four decades after its discovery, very little interest developed in it, as the Yuma Road was adjudged a superior route between the Los Angeles Basin and the Lower Colorado River (Warren et al. 1981). The Cocomaricopa Trail became a major thoroughfare only in the aftermath of the La Paz gold rush of 1862, when William Bradshaw employed this route for his famous overland stage service between

present-day Ehrenberg, Arizona, and settlements in southern California (Hogan et. al. 1992:9).

Despite the length of time during which they served as the gateway between coastal California and Arizona, these trails and wagon roads left little, if any, identifiable impact on the project area and its surrounding region. By the late nineteenth century, their role in the trans-desert communication and transportation network went into a rapid decline, as railroads succeeded in penetrating the Mojave and Colorado Deserts. Their former importance was not regained, in fact, until the 1930s, when modern paved highways (U.S. 66, U.S. 60/70, and later I-10, I-40, and Hwy. 62) began to revitalize ancient routes.

The railroads, in comparison, brought many more changes to the desert landscape. Aside from the construction of hundreds of miles of track, each railroad line brought into the desert a series of sidings with section houses to provide support for maintenance. Some of these gradually developed into so-called railroad towns, which typically prospered with the railroads in the late nineteenth and early twentieth centuries, and declined with the railroads after the Second World War.

While the trail-blazers' only interest in the Mojave Desert was to get across it as quickly as they could, another breed of Western adventurers, symbolized by their fabled shovels and pans, gradually began to realize the value of the desert itself, or rather that of the treasures buried underneath it.

In the early 1860s, as the gold mines in the Sierra Nevada declined in production, groups of former Forty-niners abandoned the old Mother Lode country and embarked on fresh explorations in the deserts of Nevada and California. Before long, new mining districts sprang up here and there in the Mojave Desert (Hill 1912:127-130). However, the discovery of these early bonanzas was frequently incidental to travel across the desert to rich diggings elsewhere, as in the case of the La Paz gold rush in Arizona (Warren et al. 1981:96). A few renowned mining towns, such as Ivanpah and Calico, boomed in the 1870s and 1880s, but the first major strike in the Mojave Desert did not occur until the Old Woman Mountains boom of 1898-1901 (Gallegos et al. 1980:133).

The Eagle mountains were involved to some degree in this early movement with the establishment of a number of iron, gold, and silver claims by Jack Moore in December, 1881 and January, 1882 (Bull et al. 1991). These and other claims were ultimately consolidated by L. S. Barnes (ca. 1912) and offered for sale to Henry E. Harriman, chief executive officer of the Southern Pacific Railroad (Bull et al. 1991; Lynch 1958).

Harriman purchased the property at a reported price of $1,512,000, purportedly to establish a local source for the iron ore needed to

found a West Coast steel industry. These efforts were intended to undercut the cost of importing rails for the Southern Pacific's lines from eastern suppliers but in effect served as leverage to drive the cost down and were never implemented (Bull et al. 1991; Lynch 1958).

The next phase in the development of Eagle Mountain began with the acquisition of the mineral claims by Henry J. Kaiser in 1944. World War II supplied a tremendous demand for domestic steel and Kaiser, with a steel mill already in operation in Fontana, California, had need of the ore (Orlo Andersen, personal communication 1995). Construction began in August, 1947 on a railroad line to serve the mine and haul ore, and this was completed on June 23, 1948 (Bull et al. 1991).

Concurrent with the construction of the railroad and the beginning phases of the mine operation, was the development of the Eagle Mountain townsite. The history of the development is available primarily through a number of photographs curated at the Kaiser offices on site. These appear to indicate a succession of houses constructed as needed to accommodate the growing worker population. Construction efforts occurred from ca. 1949 to the late 1960s, and culminated in a fully supported townsite with some 3700 residents (Orlo Andersen, personal communication 1995). The townsite in its ultimate florescence contained 914 housing units (including single family homes, mobile home sites, apartments, and dormitory housing), three schools, three churches, and a full array of commercial and recreational facilities.

LITERATURE AND ARCHIVAL REVIEW

A review of available literature, archaeological site archives, and relevant historical maps, was conducted at the Eastern Information Center, Department of Anthropology, University of California, Riverside. There have been two archaeological surveys, and no archaeological sites recorded within a two mile radius of the Eagle Mountain townsite. A brief discussion of the archaeological surveys conducted within this area is provided below.

The two archaeological surveys recorded in the immediate project vicinity (Bull et al. 1991; Swenson 1978) have included substantial blocks of land in their areas of examination and encountered no evidence of archaeologically significant properties or deposits. Both, however, point to the existence of widespread mechanical disturbance to the landform that is likely the result of mine expansion and townsite activities. Beyond these observations the two have provided little or no information regarding overall settlement patterns within the local desert and mountain environments.

RESEARCH ORIENTATION

The current investigation is intended to identify, describe, and provide an opinion regarding the significance of, any cultural resources encountered according to NHPA and CEQA guidelines. In order to document the potential of an archaeological site to contribute significant information regarding past lifeways, it is first necessary to demonstrate that it contains the classes and quantity of data needed to answer questions of historical or scientific importance. In the case of an investigation such as this a lack of well defined, recorded, site types or occupation zones, as well as the inherent limiting factors of an investigation based primarily on surface observations, require that any research question approached be rather general in scope and oriented toward regional concerns. Such questions may pertain to broad realms of cultural evolution, and might be expected to include reference to:

1.) <u>The relation of settlement pattern to environmental variables</u>
Archaeological information relative to the investigation of overall settlement patterning is likely to include both site location and content. Of primary import within the desert environment is a readily available source of water, a factor of both location and longevity of site formation for prehistoric and historical cultures.

Of equal import, decidedly so for aboriginal populations, is the depth of the local resource base and regional variations in raw materials available for exploitation. Indices of site selection relative to environmental variables might then be expected to include tool stone and food sources, as well as particular artifact types or assemblages whose use imply the primary focus of the habitation. The grouping of assemblages, within a regional context, may then lend insight into the seasonal round and/or primary subsistence strategies of the represented cultural entities.

2.) <u>Trade networks</u>
Evidence for the establishment, maintenance, and expansion of trade networks can be expected to be quite varied in nature and to include both prehistoric and historical elements. These might include exotic raw materials and artifacts or evidence of avenues of transportation such as aboriginal trails or historical road alignments. For all populations, items of trade provide some measure of contact among cultures and may be useful in interpreting the degree of dependence, or market participation, of a given people as well as the extent of any peripheral trade network.

Aboriginal artifacts indicative of non-localized trade activities might include exotic tool stone, tool types, ceramics, faunal materials, or ornaments. For historical

populations refuse materials, such as metal containers (cans) and bottles, as well as distinctive architectural elements, may be taken as indicators of participation in a larger economic and social network.

3.) Site chronology
Questions of site chronology are most easily addressed in the field by cross date comparisons of artifact types based on established sequences. For aboriginal locations in the study area, these include projectile point types and ceramic vessels, which have been described as reliable indicators of cultural affiliation. These relative chronological assignments may then be further bolstered, if possible, by the application of scientific techniques such as radiocarbon dating or obsidian hydration measurement and sourcing.

In the case of historical locations, site chronology is most often addressed on the basis of represented manufacturing techniques or architectural styles. This may include the analysis of can and bottle types (relative to both contents and manufacture), the size and configuration of structural elements, maker's marks on ceramics, and the nature of personal effects recovered.

To support an informed opinion about the ability of a site to contribute to such lines of inquiry, or to other research questions which may safely be predicted to emerge as historical and archaeological research provide additional data, it is first necessary to inventory all possible structural remains, activity areas, facilities, deposits, or modifications of surface within a given project area as the initial step in the archaeological study. The second step is to recover adequate samples from contexts representing the different periods of occupation, selected for their potential to contribute to chronological, ethnic, functional, or economic interpretations. A third stage entails laboratory analysis of those classes or categories of materials most likely to yield the desired information.

SURVEY METHOD

The subject property was examined by walking a series of parallel transects spaced at approximate 10 meter intervals and oriented as needed to accommodate the landform examined. Additional field efforts entailed the inventory and photo-documentation of existing structures within the main townsite. This was accomplished in order to allow for review of the represented architectural styles by a qualified architectural historian.

SURVEY RESULTS

The entire project area appears to have suffered extreme disturbance in the form of mechanical alteration to the landform to create construction pads for townsite structures, maintain adequate drainage from the townsite and across open space areas, and create approach avenues, railroad beds, and waste water treatment ponds. Vegetation density was light with surface visibility generally exceeding 80 percent.

Field efforts were delineated by, and accomplished according to, the individual planning areas illustrated in Figure 3 and described below.

Planning Area 1
Planning Area 1 is the present site of the Eagle Mountain Correctional Facility. The area encompasses 13.01 acres and has been completely redeveloped. According to informants (Orlo Andersen, personal communication 1995) this is the former site of the town commercial center. Due to security concerns Planning Area 1 was not subject to direct to field investigation.

Planning Area 2
Planning Area 2 is proposed for commercial/manufacturing use and includes 12.95 acres of the former townsite. Included within the boundaries of the planning area are portions of the town's mobile home site, the northernmost row of houses associated with the housing development, two commercial structures, and the current Kaiser administrative building.

Planning Area 3
Planning Area 3 includes 27.82 acres of the former town mobile home park that has been designated for employment as outdoor storage. The entire area has been subjected to mechanical cut and fill efforts focused on the creation of artificial terraces to accommodate individual trailer pads. Additional efforts have included the installation of paved roadways and subsurface utilities.

Planning Area 4
Planning Area 4 is bound by Kaiser Road and Palm Drive and includes the sites of the former town elementary school and theater. This area encompasses 9.09 acres that has been proposed for development as a community correctional facility. The existing structures are to be retained. The entire landform in this vicinity has been cut to grade to allow for the construction of the school complex and theater, with much of the westernmost portion paved and the eastern given over to athletic fields.

Planning Area 5

Planning Area 5 abuts the eastern edge of Area 4 and includes 6.98 acres of land proposed for development to commercial/manufacturing use. The area includes a single standing structure and has suffered extensive mechanical disturbance that has resulted in the creation of two large terraces, both of which have been gravel paved. The structure is one of two remaining community churches and is to be retained.

Planning Area 6

Planning Area 6 extends southward off Area 5 and includes 4.71 acres. This area has been proposed for residential employment and encompasses two existing structures and concrete slab foundations for an additional 13. The foundations are to be reemployed in the course of the proposed development. This area has been subjected to extensive mechanical disturbance focused on the creation of suitable surfaces for the construction of housing units and the installation of paved roads and subsurface utilities.

Planning Area 7

Planning Area 7 lies south of Area 6 and directly west of the Desert Center Unified School District property. The area encompasses an existing parking lot and church building and includes 4.18 acres within its boundaries. The structure is to remain for recreational use.

Planning Area 8

Proposed for commercial employment, Planning Area 8 occupies a narrow strip of land at the entrance to the community. This area includes 11.38 acres of severely disturbed lands that have been repeatedly affected by road and drainage maintenance activities.

Planning Area 9

Planning Area 9 has also been proposed for employment as a correctional facility. These 29.92 acres of former townsite have suffered extensive alteration for the purposes of housing construction and contain a number of abandoned concrete slab foundations that are proposed for future re-use.

Planning Area 10

Containing much of the former townsite, Planning Area 10 contains 90.95 acres of land proposed for residential use. This area contains a substantial number of single family wood frame dwellings that are further described below. Based solely on field observations, it would appear that early efforts at development of the townsite occurred along the northern and western limits, near

the current administrative building, and continued south and east as demanded by the growing population associated with the mine site.

The natural landform in this area has been entirely obliterated by the cut and fill operations necessary to create the regular series of terraces and pads required for the orderly construction, and drainage, of the townsite. Additional disturbance to the landform has occurred in the form of subsurface utility installations, and the construction of paved roads.

Planning Area 11

Planning Area 11 is the current site of, and proposed continued location for, the townsite waste treatment area. This location has suffered extensive mechanical disturbance, designed to create a series of earthen berms for the purpose of enclosing wastewater treatment ponds. Due to health concerns only areas peripheral to the fenced existing ponds were subjected to direct pedestrian investigation.

Planning Area 12

The 168.16 acres included in Planning Area 12 have been proposed for employment as open space/recreation areas. The landform in this vicinity has also been subjected to extensive mechanical alteration. These activities have included the creation of a network of dirt roads and tracks, the construction of an elevated railroad berm, and the maintenance of primary drainage avenues from the townsite and mine areas.

A single isolated artifact of apparent prehistoric origin was encountered within the boundaries of Planning Area 12. The artifact is represented as a milling stone fragment manufactured from a green metasedimentary material (Figure 4). The artifact has been pecked to shape with the upper surface exhibiting some polish evident of use wear and the base flattened to stabilize. The fragment is largely triangular in shape and measures 16 x 13 cm in maximum dimension and ranges from 4 to 6.5 cm in thickness.

The milling stone was noted some 20 m south of the existing railroad bed approximately 75 m east of its intersection with Old Eagle Mountain Road (Figure 5). The artifact was located within a disturbed context along the northern edge of a bulldozer cut paralleling the railroad bed. The artifact was designated as EM-ISO#1 and a formal record of the isolated find filed with the appropriate information center.

Structural Inventory

As part of the field investigation an inventory of dwelling types represented within the Eagle Mountain Townsite was accomplished.

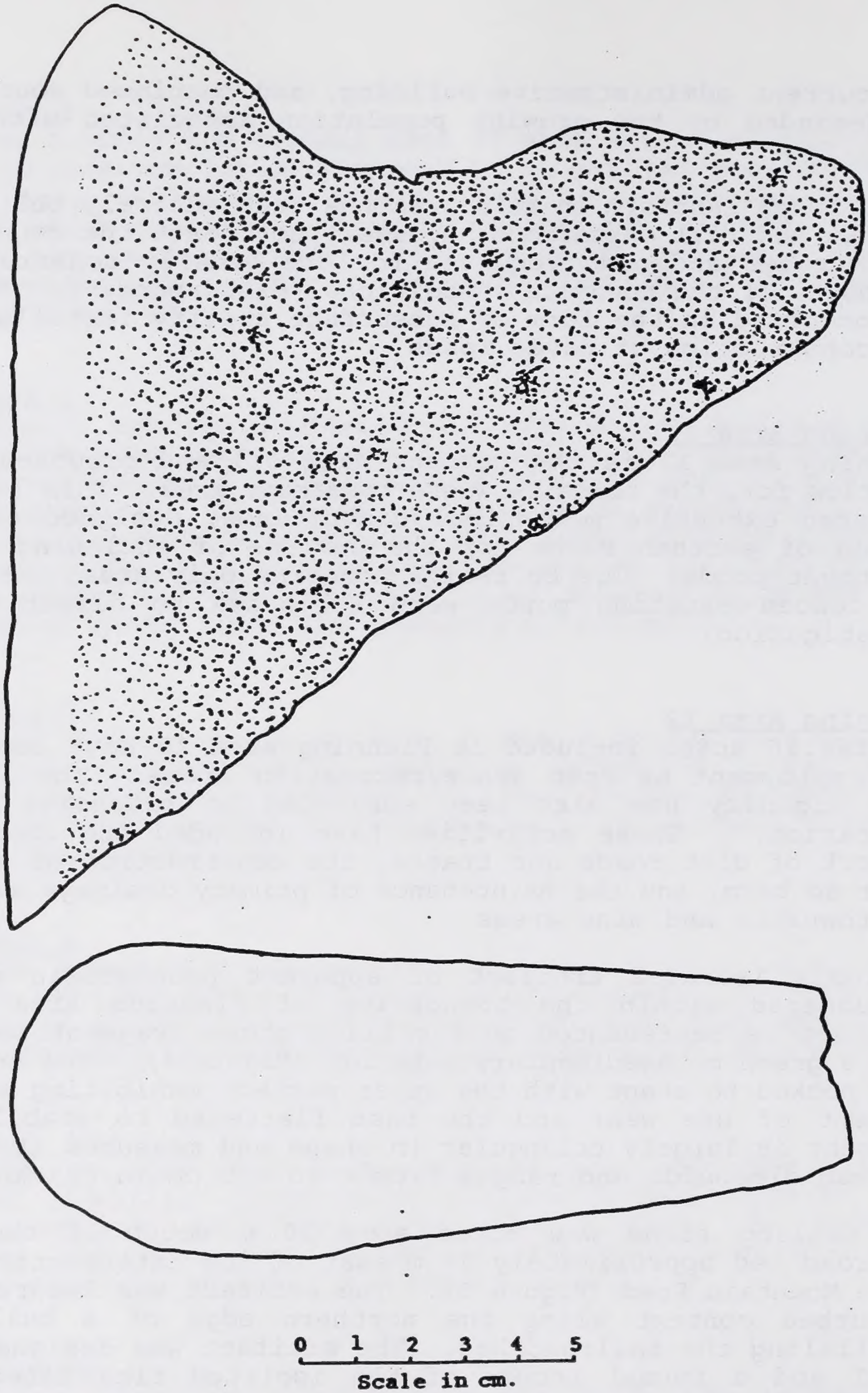

Figure 4
EM-ISO#1
Milling Stone Fragment

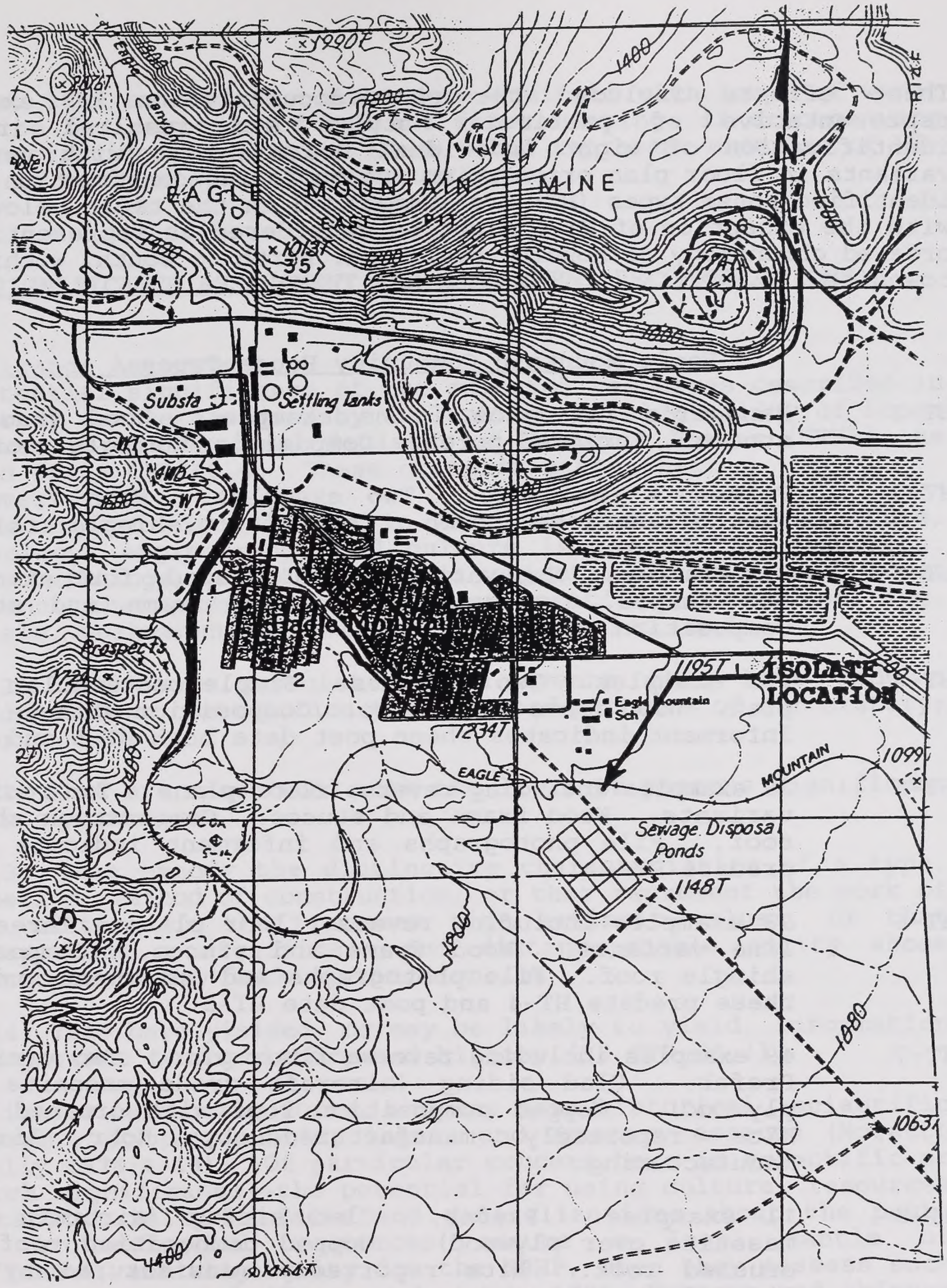

Figure 5
Isolate Location Map
Source: USGS 7.5' Victory Pass Quadrangle
Scale 1:24,000

These efforts included the photo-documentation of examples representative of particular styles and resulted in the identification of eight individual house types, with assorted variants in floor plan orientation and roof line construction. The identified house types (HT) are summarized in the table below, and with the exception of HT-4 might be considered as representing an ordered chronology of housing evolution, north to south, within the townsite.

Eagle Mountain Community House Types

HT-1	Manager's residence. One example. Wood frame and stucco. Enclosed porch. Composition shingle roof.
HT-2	Foreman's residence. Two examples. Wood frame and stucco. Enclosed porch. Composition shingle roof.
HT-3	Six examples. Two variants. "L" shaped, four examples; "C" shaped, two examples. Wood frame and stucco. Composition sheet roof.
HT-4	139 examples. Two variants. Simple rectangular floor plan. Wood frame and stucco. Composition shingle roof. Informant indicates these post date both HT-5 and HT-6.
HT-5	26 examples including reverse floor plans. Two roof line variants. Wood frame and stucco. Composition shingle roof. File photographs and informant indicate these predate HT-6.
HT-6	96 examples including reverse floor plans. Three roof line variants. Wood frame and stucco. Composition shingle roof. File photographs and informant indicate these predate HT-4 and post date HT-5.
HT-7	49 examples including reverse floor plan. Two variants. Prefab. Clad siding (aircraft grade masonite over plywood). Mopped composition roof with crushed rock. Kits reportedly manufactured by Rohr Aircraft manufacturing.
HT-8	11 examples. Prefab. Clad siding (aircraft grade masonite over plywood). Mopped composition roof with crushed rock. Kits reportedly manufactured by Rohr Aircraft manufacturing.

Note: All wood frame and stucco houses have detached garages. Garages are attached to prefab structures. All structures have been erected on concrete slab foundations. File photographs of construction efforts appear to indicate that

ca. 1953 some of the slabs were equipped with loops of water pipe for purposes of radiant floor heating; if accompanying descriptions are correct these would represent examples of HT-6 in early stages of construction.

SIGNIFICANCE ASSESSMENT AND MANAGEMENT RECOMMENDATIONS

Significance Assessment

The potential significance of the cultural resources described in this study can be assessed by evaluating the eligibility of those resources to the National Register of Historic Places (NRHP), as defined in 36 CFR 60.4. These criteria state that:

The quality of significance in American History, architecture, archaeology, engineering, and culture is present in districts, sites, buildings, structures, and objects of State and local importance that possess integrity of location, design, setting, materials, workmanship, feeling and association, and:

(1) That are associated with events that have made a significant contribution to the broad patterns of our history; or

(2) That are associated with the lives of persons significant in our past; or

(3) That embody the distinctive characteristics of a type, period, method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack distinction; or

(4) That have yielded, or may be likely to yield, information important to prehistory and history [36 CFR 60.4].

Significance takes many forms, and may have historical, scientific (research), ethnic, public, legal, and monetary aspects (Moratto and Kelly 1978:4-18). Of particular concern here is scientific or research significance--the potential for using cultural resources to establish reliable facts and generalizations about the past. Thus, archaeological resources assume a legal mantle of significance, and eligibility for the NRHP, when they possess such information potential (Greenwood et al. 1991; Hampson and Skinner 1990). In turn, eligibility prescribes that such resources are to be managed. Noneligible resources have no standing under the law, and their management is not required. The appraisal offered in this report is a preliminary evaluation of significance, that is, a professional opinion. Actual determinations of NRHP status are made by the Keeper of the National Register, in consultation with

the State Historic Preservation Officer (SHPO).

The scientific significance of individual cultural resources is best judged with reference to broad, regional context. This is because individual sites, or even arrays of sites from a single locality cannot reflect the full range of cultural patterning present in a particular region (Schiffer and Gumerman 1977; Greenwood et al. 1991).

Assessing scientific significance thus involves the examination of a large array of possible articulations between data and research issues--issues which might include studies of chronology, technology, subsistence, architecture, settlement patterns, exchange systems, paleoenvironments, ethnic affiliations, demography, and other research domains in prehistory and during the historical period. The discovery of a house floor or other structural remains, for instance, may signal potentials for research in the domain of architecture; charcoal, projectile points, or bottles permit the study of chronology; exotic tool stone, shell beads, and ceramics are items that might enable studies of trade and commerce (Greenwood et al. 1991; Hampson and Skinner 1990).

An important consideration when evaluating a site's potential to yield significant information is the integrity of its constituents. During field recordation of sites for this investigation prior surface impacts were noted. However, research potentials may be identified even in severely disturbed surface contexts (single components of previously impacted sites may provide valuable data on technology), and thus all sites require careful assessment (Talmage and Chesler 1977; Greenwood et al. 1991).

In addition to scientific significance, both Native American and historical non-native cultural resources may possess public and ethnic values. For instance, persons associated with a particular site (or their descendants) may retain strong connections with that place through memories and folklore. The importance of this aspect of significance lies not only in the strength of these associations as they contribute to broad patterns of history, but also in the valuable yet ephemeral source of information such memories represent. Cultural resources may also have broader public significance insofar as they can serve to educate the general populace about important aspects of national, state, and local history and prehistory.

<u>Discussion</u>
While a general scatter of modern discards, including milled lumber, sanitary crimp cans, fragments of formed concrete slabs, as well as fragments of clear, common green, and brown bottle glass were noted, no significant cultural resources of historical origin were encountered in the course of the field examination.

The structures described above, while of some interest for their role in establishing the chronology of townsite development do not appear capable of contributing further information to the archaeological record as examples of a particular type, period, or method of construction. In a like manner the structures, and the associated townsite, do not appear eligible for inclusion as a district in the National Register of Historic Places.

EM-ISO#1, the isolated milling stone, may be taken as an indicator of at least casual employment of the local landform by native populations. The presence of this artifact within the active alluvial fan of the project area gives rise to questions concerning the nature of its primary deposition and the effects of wind and water in the movement of soils and their constituents across the landform. It has been suggested that landforms such as that represented in the project area may be associated with buried cultural deposits. These areas include floodplains, mountain valleys and basins, wetlands, and fault zones. In this light locations such as that here represented may have the potential to provide additional information regarding regional prehistoric lifeways in the form of obscured, or buried deposits.

However, no additional artifacts, flakes or debitage, faunal remains, midden soil or features of prehistoric origin were observed. The negative results of the survey efforts suggest that no significant cultural resources are, or were, present in the area investigated, although, the extensive nature of the disturbance suffered by the landform may have effectually removed any such evidence for previous habitation.

<u>Management Recommendations</u>
It is our opinion that Kaiser's proposed redevelopment of the Eagle Mountain townsite will entail no further direct or indirect impact upon significant cultural resources, and may in fact serve to preserve the associated structural elements. This investigation has resulted in the complete surface examination of all the proposed townsite lands, and has included an inventory of represented structures. There is no recommendation that further archaeological efforts be expended at this property.

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Appendix K-2

Cultural Resource Survey of the Eagle Mountain Mine and the Kaiser Industrial Railroad

CULTURAL RESOURCE SURVEY
OF THE
EAGLE MOUNTAIN MINE
AND THE KAISER INDUSTRIAL RAILROAD
CULTURAL RESOURCE PERMIT #CA881916

Prepared for

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RECON NUMBER 2100A
JUNE 9, 1991

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ATTACHMENTS

FIGURES

I. INTRODUCTION

In response to a proposal by Mine Reclamation Corporation to develop the Eagle Mountain Open Pit Iron Mine into a solid waste disposal site, a team of archaeologists from RECON conducted a cultural resource inventory of approximately 4,659 acres surrounding the mine, including approximately 3,271 acres of Bureau of Land Management (BLM) land slated for Kaiser Steel Resources, Inc. ownerships. The survey also included approximately 1,500 acres of Kaiser-owned lands located along the Chuckwalla Bench which will be exchanged for the BLM land. The 52-mile-long Kaiser railroad running from Eagle Mountains to Ferrum Junction and the existing Eagle Mountain Road and its proposed extension are proposed as access routes to the proposed landfill site. A 200-foot-wide corridor along all these access routes was surveyed (Figures 1 and 2).

Prior to commencing fieldwork, an achival record search was conducted using the resources of the Archaeological Research Unit of the University of California, Riverside. The information gathered from the record search is included with this report as Attachment 1.

Field investigation conducted in 1990 took 98 person-days, conducted simultaneously by two field teams. One team concentrated on the area north of Interstate 10, including the area surrounding the mine, while the other team was assigned to cover the rail corridor and acreage south of the highway. Each team of four archaeologists operated independently until the railroad corridor survey was completed, when the teams were joined to complete the survey of the mine area. In February and March, 1991, eight additional person days were expended completing the field survey of 480 acres of additional BLM exchange lands located on the southern portion of the Specific Plan Area and conducting additional documentation at site Riv-3798.

The survey discovered one previously unrecorded prehistoric site, field designation EMRR-1, as well as nine isolated prehistoric artifacts (Figure 3). EMRR-1 was assigned California trinomial CA-Riv-3798. No previously recorded historic sites were discovered. Department of Parks and Recreation forms (DPR-422a) were completed for each newly located site and isolate and are attached to this report as Attachment 2.

Riv-3216, which was mapped as lying within the area surveyed, was not relocated by the survey team. Riv-3798 consists of a scatter of potsherds and lithics on the southwest-facing slope of a knoll. A major portion of the site has been removed by the excavation of a 10-meter-deep and 20-meter-wide corridor for the railroad tracks.

Since the railroad tracks have cut into the site area, there is no cultural material near the tracks. The nearest relatively undisturbed ground lies about 10 meters to the north of the tracks.

Rehabilitation and use of the railroad and required maintenance activities (which are the only actions proposed for the project in this area) will not involve excavations or movement of dirt. Because the project will have no effect on the resource, no further evaluations are required.

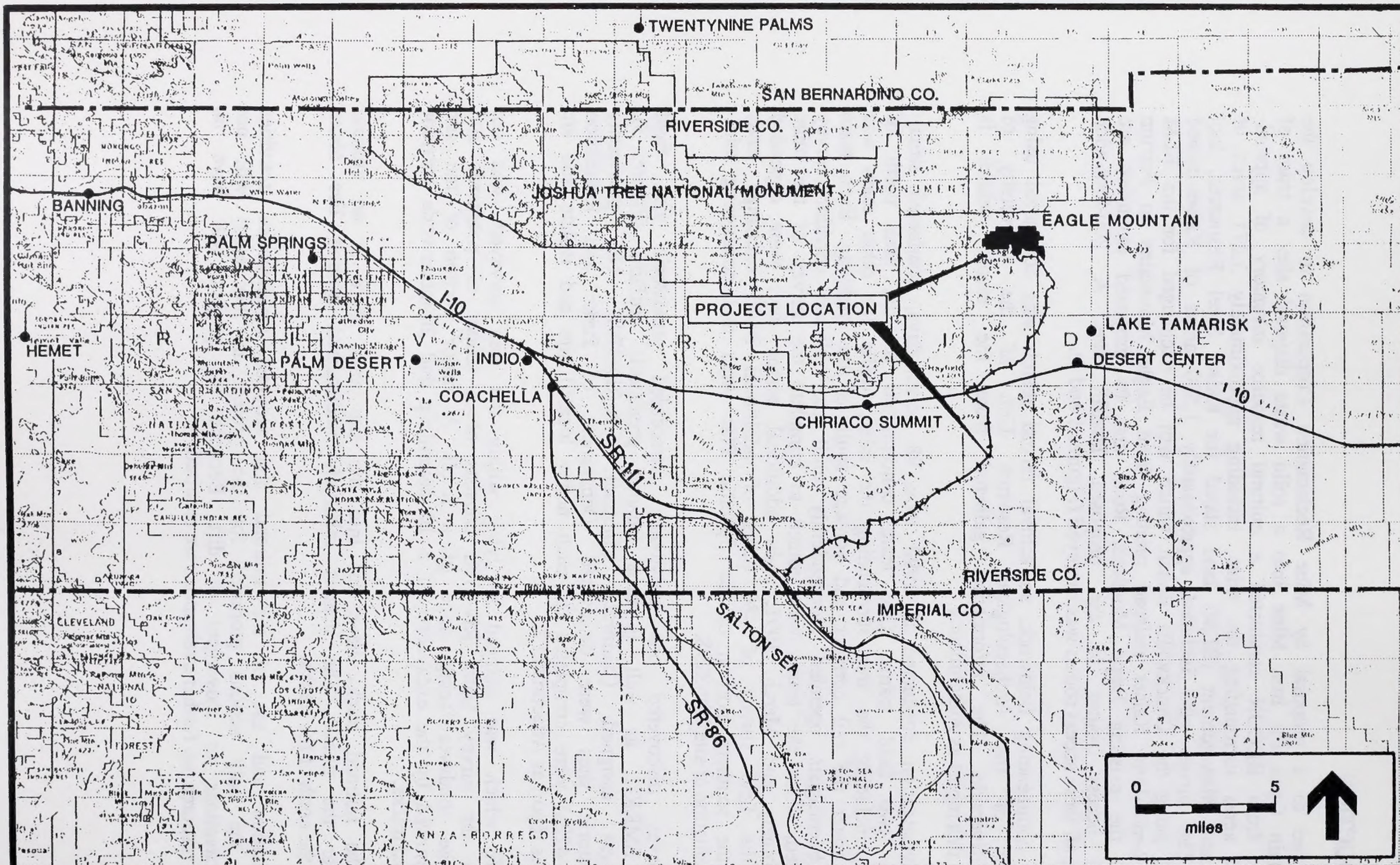

FIGURE 1. PROJECT LOCATION RELATIVE TO EASTERN RIVERSIDE COUNTY

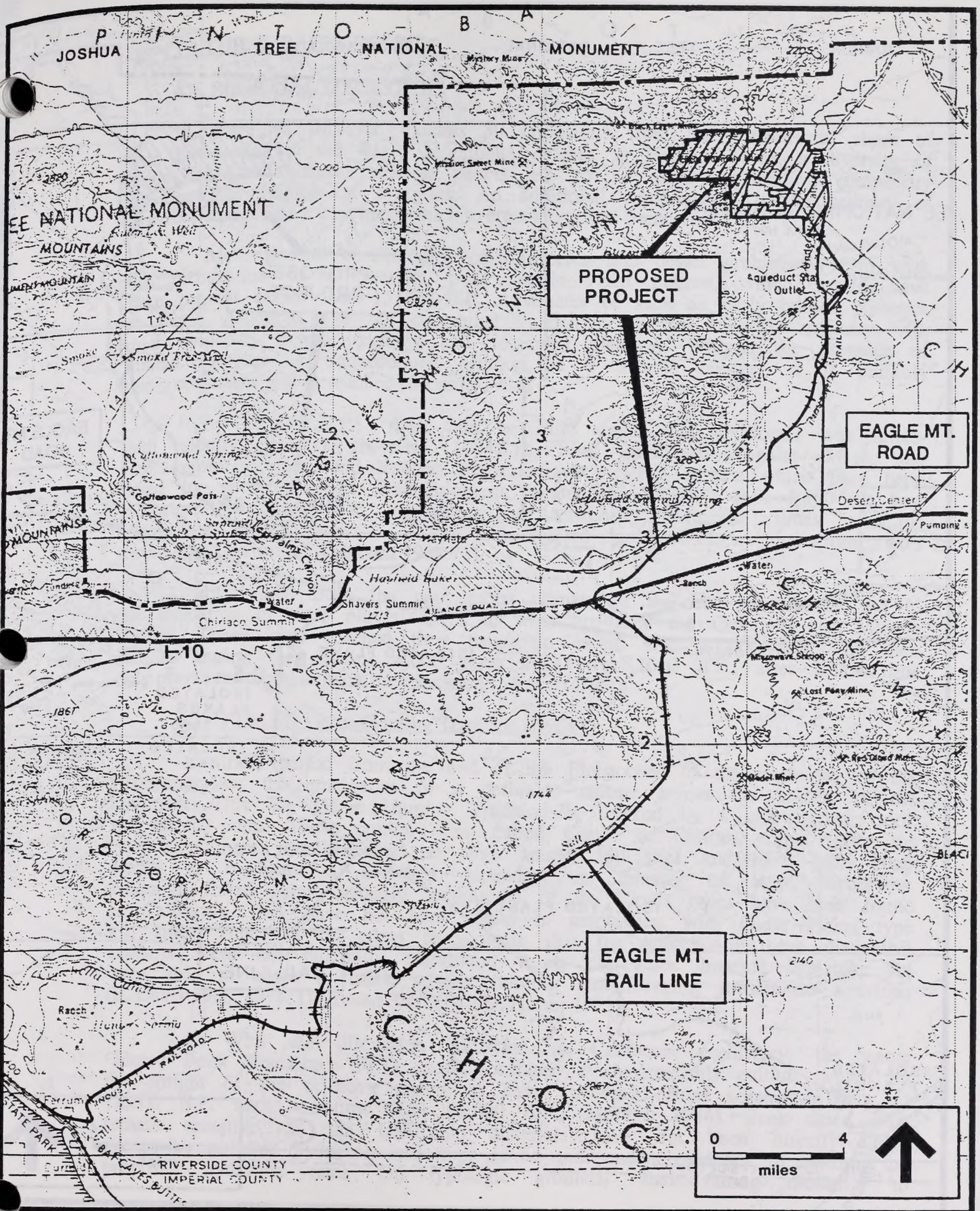

FIGURE 2. PROJECT LOCATION ON U.S.G.S. 1:250,000 SCALE MAP, SALTON SEA SHEET

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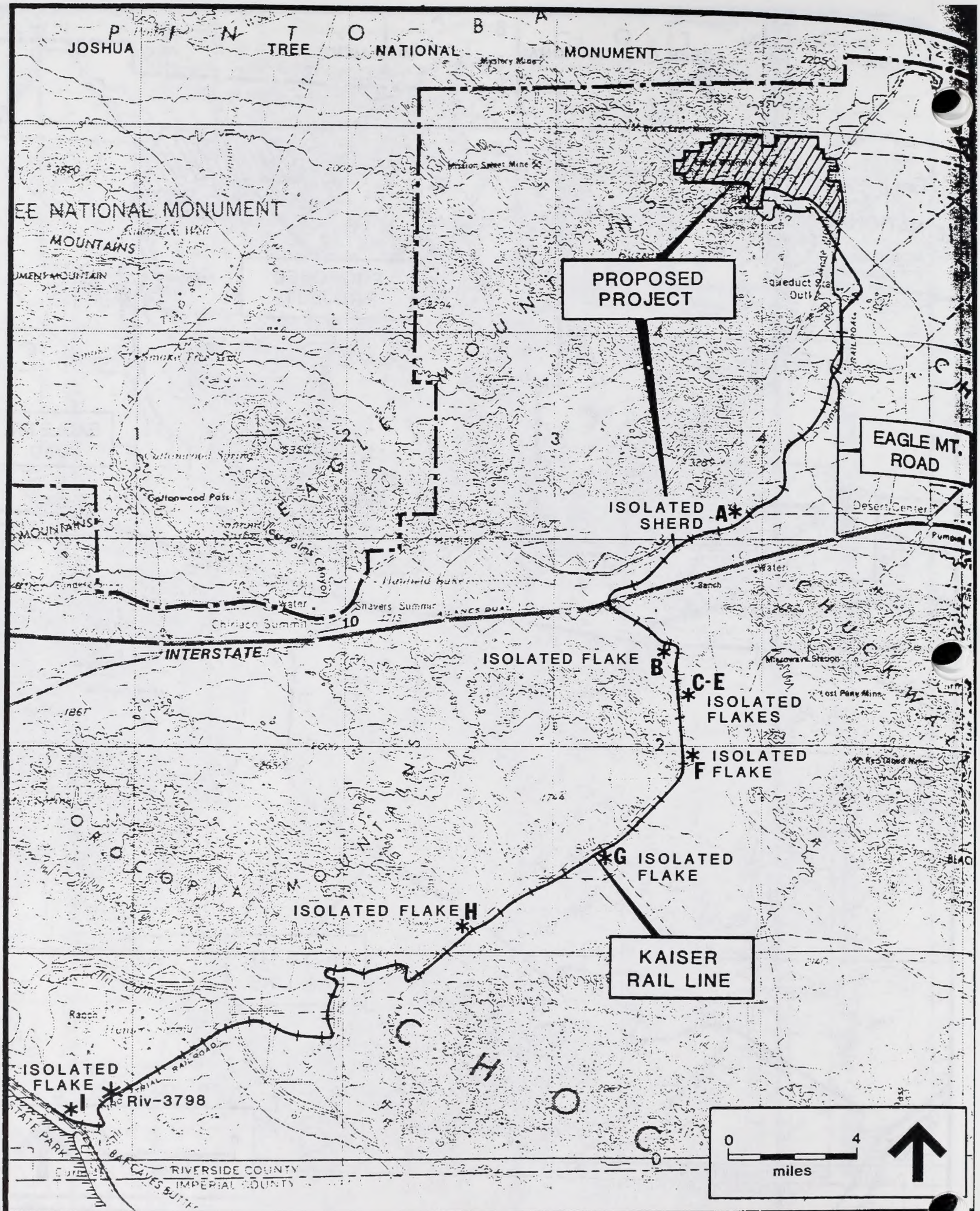

FIGURE 3. LOCATION OF CULTURAL RESOURCES

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II. CULTURAL BACKGROUND

A. REGIONAL OVERVIEW

The area surveyed extends 80 kilometers from the northeastern shore of the Salton Sea to the Eagle Mountains. Within so large an area, a diversity of prehistoric and historic cultural patters are to be expected, lending complexity to even the briefest of synopses. An additional complication is the scarcity of previous investigative data upon which to erect a regional framework.

Most general chronologies of California and desert prehistory begin with the recognition of a possible pre-Projectile Point culture, which would have been present earlier than 15,000 B.P. Advocates of such an early human presence in North America have not succeeded in convincing the scientific majority with their evidence, despite ongoing and vehement dialogue. Without the presence of human remains or unquestioned artifacts in a datable context, it is unlikely that a consensus will be reached (Moratto 1984).

By 15,000 B.P., "there can be little doubt that California was inhabited, albeit sparsely" (Moratto 1984:71). Sites such as Angeles Mesa, the Farmington Complex, and Rancho Murieta have yielded artifacts which have been dated by geomorphologic association at greater than 12,000 B.P. But "the best indicators of widespread occupation in terminal Pleistocene times are the Clovis-like fluted points . . . and related artifacts from numerous sites throughout California" (Moratto 1984:71).

By 14,000 B.P., the cool moist climate of the Late Pleistocene led to the formation of deep pluvial lakes in what are now the Colorado and Mojave deserts. These lakes reached their maximum extent after 11,000 B.P. and then receded during the ensuing 4,000 years until circa 7000 B.P., after which time only playas remained to mark their location (Moratto 1984).

1. The Big Game Hunting Tradition (BGHT)

The period from the end of the Pleistocene to the beginning of the Holocene saw the emergence of a definable culture across the middle of the continent. This Big Game Hunting Tradition is marked by a characteristic tool: the fluted point. These points, often called Clovis or Folsom points (after the type sites), are usually found at large animal kill sites and have been interpreted to represent a life-style dependent on hunting of large herbivores. Although fluted points strongly reminiscent of the Clovis types have been found in California, they have not been found in association with Great Plains type kill sites. This can be taken to indicate that the makers of these distinctive artifacts were not culturally committed to a big game hunting life-style but were able to adapt to more general hunting and foraging subsistence activities (E. Davis 1968, 1974; Davis and Shutler 1969; Hester 1973).

With the discussion restricted to California prehistory, the name "Fluted Point Tradition" (FPT) more accurately designates this culture, which by the weight of the evidence seems to have flourished from somewhat prior to 12,000 B.P. until sometime after 11,000 B.P. (Moratto 1984). Such dates must remain tentative, as the California materials have not been directly dated except by obsidian hydration and there is no independent evidence to confirm the proposed hydration rates. On typologic grounds, "their strong similarity to

[radiocarbon] dated specimens farther east implies production in the millennium after 12,000 B.P." (Moratto 1984:87).

During this time frame, evidence is conclusive that many parts of California were inhabited, and sufficient data has been accumulated to allow some assessment of the cultural patterns then present. Three common traits have been identified which characterize the life-style of the FPT:

a. Inland sites are found on the margins of now vanished lakes.

b. Finished lithic artifacts are carefully crafted.

c. The assemblage includes a wide range of specialized and distinctive tool types.

The implication of these traits is that the people who developed the Fluted Point Tradition were, in interior California at least, followers of a generalized hunting and gathering life-style, which was not dependent on large migratory herd animals. These people were adept at exploiting the rich resources in the vicinity of permanent water supplies and were not required to develop the specialized hunting strategies seen in Great Plains sites of this period.

Coincident with the emergence of the Fluted Point Tradition in southeastern California, massive faunal extinctions occurred. The rapid climactic changes which also mark this period undoubtedly were the prime cause of these extinctions, but it is reasonable to assume that the appearance of a substantial population of humans who preyed on the larger herbivores was a significant contributing factor in the rapid demise of many of the previously abundant genera (Kurten and Anderson 1980).

2. <u>The Western Pluvial Lakes Tradition (WPLT)</u>

To describe the culture which apparently appeared subsequent to the Fluted Point Tradition, Bedwell (1970) defined a Western Pluvial Lakes Tradition which extended throughout the Great Basin and into the currently desert regions of southeastern California. By 10,000 B.P., this part of California from China Lake extending well into what is now Mexico held more than ten large bodies of fresh water (Snyder et al. 1964). The southernmost and largest of these pluvial lakes was Lake Cahuilla, which, unlike the others, was intermittently present at varying levels until approximately 500 B.P. (Rogers 1945).

Unlike the earlier periods, where information is fragmented and conclusions are highly tentative, this period in the prehistory of the California desert has been well investigated. Although much of the terminology is unique to the individual investigator, it is possible to lump the Playa, San Dieguito, Lake Mojave, and Death Valley I, as well as non-fluted point shoreline assemblages, into the Western Pluvial Lakes Tradition and clarify rather than obscure the close relationships among the assemblages representing these cultures (Bedwell 1970; Hester 1973). "In all probability, they represented regional variants of an early hunting tradition that prevailed over a wide area" (Wallace 1978:27).

The characteristics which unify the various subcultures under the WPLT are:

a. Sites are generally found on or near former pluvial lakes and marshes or along ancient streambeds.

b. The tool kits and faunal remains indicate that hunting was a primary subsistence activity. The presence of gathered vegetal matter in the diet may be assumed.

c. The assemblages lack ground stone elements.

d. The chip stone tool industry features percussion-flaked foliate points and/or knives, Silver Lake and Lake Mojave points, and a variety of long-stemmed points like those from Lind Coulee (Hester 1973).

e. Additional members of the stone tool kit include crescents, large scrapers fashioned on both flakes and cores, and drills and gravers.

Because most WPLT sites usually occur on exposed surfaces where stratification is absent, the relationship of the WPLT to the Fluted Point Tradition has not been defined with any exactitude. The FPT is apparently the elder of the two, though this is primarily based on cross-stratigraphic associations at other sites. Although WPLT assemblages do not exhibit the characteristic fluted point which defines the FPT, the two are "clearly . . . related both technically and economically" (Moratto 1984:93).

The wetlands adaptation that is embodied in the WPLT persisted as long as the climate was wet enough to keep the lakes in existence, but by circa 7000 B.P., the evaporation of the lakes in the face of a warming and drying climatological trend (Bedwell 1970) presented the aboriginal population with a severe challenge. The archaeological record reflects their cultural response.

3. The Late Cultural Sequence

The initial late cultural sequence for the Colorado Desert was developed by Malcolm Rogers (1929a, 1929b, 1945, 1966). Other investigators amended and expanded Rogers' sequence as new material was discovered. W. J. Wallace (1962) developed a four-stage sequence featuring absolute dates which differed significantly from those proposed by Rogers. Using the data from the Rose Spring site, Lanning (1963) proposed a chronology which was applicable to the northern portion of the California desert. To impose chronological discipline on an increasingly complex situation, Bettinger and Taylor (1974) published a chronology which made no attempt to order the cultural affiliations, but rather presented a series of definitive time markers in the form of projectile points. Warren and Crabtree also published this type of chronology (1972). Warren also published (1980) a slightly modified chronology which was accepted by Moratto (1984) for use in his synthesis of California prehistory. This sequence (from the end of the WPLT) consists of the Pinto period from 7000 B.P. to 4000 B.P., followed by the Gypsum period (4000 B.P. to 1500 B.P.), the Saratoga Springs period (1500 to 800 B.P.), and ending with the Protohistoric

period, which includes all prehistoric events following 800 B.P. (Moratto 1984:409-430).

a. <u>The Pinto Period</u>. The Pinto period derives its name from the Pinto Basin site, where most of the early archaeology was done by Elizabeth and William Campbell (Campbell and Campbell 1935). Although very few sites dating from this period have been excavated, the "index fossil," a coarsely made, usually shoulderless point, has been recovered from surface finds over most of the area. No site in the Colorado Desert has yielded materials suitable for radiocarbon dating, but cross-dating by comparison with similar Pinto points from the Mojave desert indicates that the Colorado Desert materials are more recent than 5,000 B.P. (Hester 1973).

An unresolved problem concerning the Pinto period chronology derives from the absence of cultural material representing the earliest parts of the time span. Some investigators, noting the lack of material datable to between 7000 B.P. and 5000 B.P., argue that during this span, the Colorado Desert was probably unpopulated. This cultural hiatus is explainable by the warm, dry conditions which would have made life in the area difficult at best (Wallace 1962). Others, working with the same data, argue that if such a break in occupational history of the region did occur, the gap would be reflected by a discontinuity in the archaeological record. Since they do not detect any such disjuncture, these regions were necessarily occupied without significant interruption (Warren 1980).

Accepted generalizations concerning the life-style represented by the Pinto materials are based on the amount and type of artifacts recovered from the sites. The small assemblages reported for most sites indicate that these sites represent temporary or seasonal camps, and the artifact types argue for a subsistence pattern which depended on hunting as well as exploitation of available vegetal matter, but without a well-defined seed-milling technology. In addition to the characteristic Pinto points, the typical Pinto assemblage contains heavy keeled scrapers, manos, and flat, highly polished slabs whose exact use is the subject of some disagreement (Campbell and Campbell 1935; Rogers 1939). The Campbells describe these artifacts as milling stones, but Rogers disagrees, citing their smoothness as rendering them ineffectual for milling and proposing that they represent a surface upon which hides and/or fibrous plants such as yucca were scraped.

Temporal placement of the Pinto period is somewhat dependent on interpretation of the function of these smooth-surfaced stones, for if they were not adaptable to hard-seed milling, then the ability of the culture to prosper in arid conditions is questionable (Moratto 1984). If, however, conditions at the time represented by the Pinto Basin period were not arid, then the apparent unsuitability of these distinctive artifacts for milling does not pose a problem. Moratto (1984) proposes a series of alternating wet and dry periods, with the population expanding into the desert during the wetter periods and retreating to the margins of the desert and to scattered oases as the climate became more arid. While his remarks are directed at the Pinto period populations in the Mojave Desert to the north, they apply equally to the Colorado Desert.

b. <u>The Gypsum Period</u>. Just as the Pinto period is distinguishable from the earlier WPLT by its characteristic artifacts, the subsequent Gypsum

period (4000 B.P. to 1500 B.P.) is similarly distinguished by a change in the types of projectile points recovered. Any combination of Humboldt Concave Base, Gypsum Cave, Elko Eared, or Elko Corner-notched points in the assemblage justify the assignment of the site to the Gypsum period (Moratto 1984). In addition to these diagnostic elements, leaf-shaped points and knives, rectangular knives, drills, large flake scrapers, choppers, and hammerstones are regularly present. For the first time in desert assemblages, manos and milling stones appear regularly.

The cultural affiliations of Gypsum period sites seem dependent on the background of the investigator, with strong reminiscences of both Great Basin (Heizer and Berger 1970; Hester 1973; Bettinger and Taylor 1974) and Southwestern (Rogers 1939) cultures. Both interpretations agree that the Gypsum period material is logically descendent from the earlier Pinto period, with the changes in the tool kit being evolutionary, rather than reflecting any radical shift in cultural patterns. A distinctive Southwest influence is seen in several sites (particularly Newberry Cave) in the form of split-twig figurines, which are "miniature animal figurines, constructed of a single long, thin willow branch, split down the middle, bent and folded so as to create a representation of an animal" (Moratto 1984:417).

Schroedl, in his analysis of these split-twig figurines (Schroedl 1977), determined that this class of artifact was found in two distinct locations. The first type of site where the figurines are found consists of a relatively inaccessible cave, and the figurines are not found in conjunction with any other cultural materials. In this context, the figurines are sometimes pierced by another twig, as if the animal was speared. In the second type of site, the caves are easily accessible, the figurines evidence no special consideration, and the figurines are located in conjunction with normal occupational debris. Where the cultural inventory included projectile points, Gypsum Cave points are most frequent. Schroedl (1977:263) interpreted this dichotomy as indicating a change in the way figurines were regarded. Where the figurines are found cached in remote caves, he infers religious significance; and where the figures are located in conjunction with other artifacts, he infers "toys or playthings."

Newberry Cave also is important for its pictographs, which apparently date from the same (Gypsum period) time as the split-twig figurines and which depict some sort of animal (C. A. Davis 1981). Davis interprets these as representing a bighorn sheep hunting ritual. A similar ritual has been inferred from petroglyphs in the Coso Mountain range (Grant et al. 1968). At Coso, the petroglyphs also illustrate the change from atlatl to bow and arrow, a transition which began within the Gypsum period.

Another Gypsum period site of importance is the late phase of Mesquite Flats, as it marks the appearance of mortars and pestles (Wallace 1977). These tools were employed in exploitation of mesquite pods well into the historic period, and their presence suggests that processing mesquite is also a Gypsum period innovation.

Another innovation, in the form of *Haliotis* and *Olivella* shell beads, also appears during the Gypsum period. These beads occur over a wide area but in relatively small numbers in each site (Moratto 1984) and are proof of contact with coastal California natives.

The Gypsum period represents a period in which the Native American populations of the area became adapted to the dry desert conditions. Technological changes and innovations outlined earlier, as well as the appearance in the archaeological record of proof of trading, mark this period as the beginning of regional diversity, when the life-style of the desert peoples becomes easily distinguishable from that of the adjacent populations.

c. Saratoga Springs Period. Regional differences, which began to become apparent during the preceding Gypsum period, become more pronounced during the subsequent Saratoga Springs period (1500 B.P. to 800 B.P.). In the northwestern Mojave Desert, the change is defined where Rose Spring and Eastgate points replace the previously prevalent Elko and Humboldt points. These smaller points are interpreted to represent increased replacement of the atlatl by the bow and arrow, a change first depicted in the Gypsum period Coso petroglyphs mentioned earlier. Farther east in the Mojave, Anasazi influence is observed. The Anasazi were centered east and north of the California deserts and came to the region ostensibly to exploit deposits of turquoise. This is evidenced by large number of aboriginal mines (Rogers 1929a). Turquoise from the mines at Halloran Springs has been identified at the Snaketown (Arizona) site in levels dated 1500 to 1300 B.P. (Sigleo 1975).

In the Colorado Desert region, the accumulation of evidence points toward cultural influences from the lower Colorado River area, even though evidence which would conclusively decide the issue is lacking. Only the Willow Beach site, which is located in an area of Anasazi as well as Hakataya influence, contains cultural materials older than 1200 B.P., and the data recovered from there does not represent a transition from Gypsum to Saratoga Springs (Moratto 1984).

One apparent difference in the assemblage between Colorado Desert sites of this period when compared with coeval sites in the northwestern and eastern Mojave Desert is the prevalence, in Colorado Desert assemblages, of the triangular Cottonwood series of projectile points as opposed to the Rose Spring points found at the Mojave sites. These sites containing Cottonwood points correspond to Rogers' (1945) nonceramic Yuman culture. Another aceramic site containing Cottonwood series projectile points is Oro Grande, dated to 1100-900 B.P. (Rector et al. 1979). This site is located west and north of the Colorado Desert, but shares Hakataya affinity rather than the Anasazi influence found to the north and east.

As stated earlier, there is insufficient evidence to prove the inferred division of the region into two competing spheres of influence, Anasazi and Hakataya. The Anasazi entered the desert to exploit turquoise deposits, but no such clear goal can be attributed to the Hakataya. The occurrence of coastal shell in Colorado River sites of the period fuels the proposition that these desert incursions were trade expeditions, without long-term settlement.

Toward the end of the Saratoga Springs period, ceramics, in the form of Colorado Brown and Buff wares, appear in the Colorado Desert (May 1976). Also, Desert Side-notched points join the preexisting Cottonwood series points. Both of these artifact types are interpreted as evidence of increased Hakataya influence (Moratto 1984).

d. The Protohistoric Period. The period which follows the Saratoga Springs period is called the Protohistoric: from 1200 A.D. to European contact (Moratto 1984). During this period, the cultural divisions which had been developing for more than 1,000 years have become very visible, and the Colorado Desert was unified under strong Hakataya influence. This unification is visible in the archaeological record in the form of Brown and Buff wares and Desert Side-notched projectile points, which dominate the assemblages. The Hakatayan influence has spread into the southern Mojave Desert, following the withdrawal of the Anasazi after circa 1150 A.D. Further, trade with coastal California native groups is common, given the regular occurrence of shell items in the assemblages. Large well-developed village complexes along the Mojave River and in the Antelope Valley undoubtedly were supported by the increasing coastal-desert commerce (Smith 1963; Sutton 1981), though the Antelope Valley sites reflect more coastal than desert influence, while the opposite is true of the sites along the course of the Mojave. At least one large village complex has been documented in the Colorado Desert (Schaefer 1988). It is probable that occupants of this village traveled seasonally from the coastal mountain foothills to the Colorado River to exploit food resources.

The Mojave River trade route apparently was not a self-sustaining economic entity, because both Rogers (1945) and Sutton (1981) report a drop in apparent population levels and abandonment of sites toward the end of the period. Two explanations for this apparent decline in trade are suggested by Moratto (1984). One possibility is that the lakes in the Cronise Basin desiccated. The alternative is that the Chemehuevi tribe migrated from the north to a "blocking position" athwart the trade route.

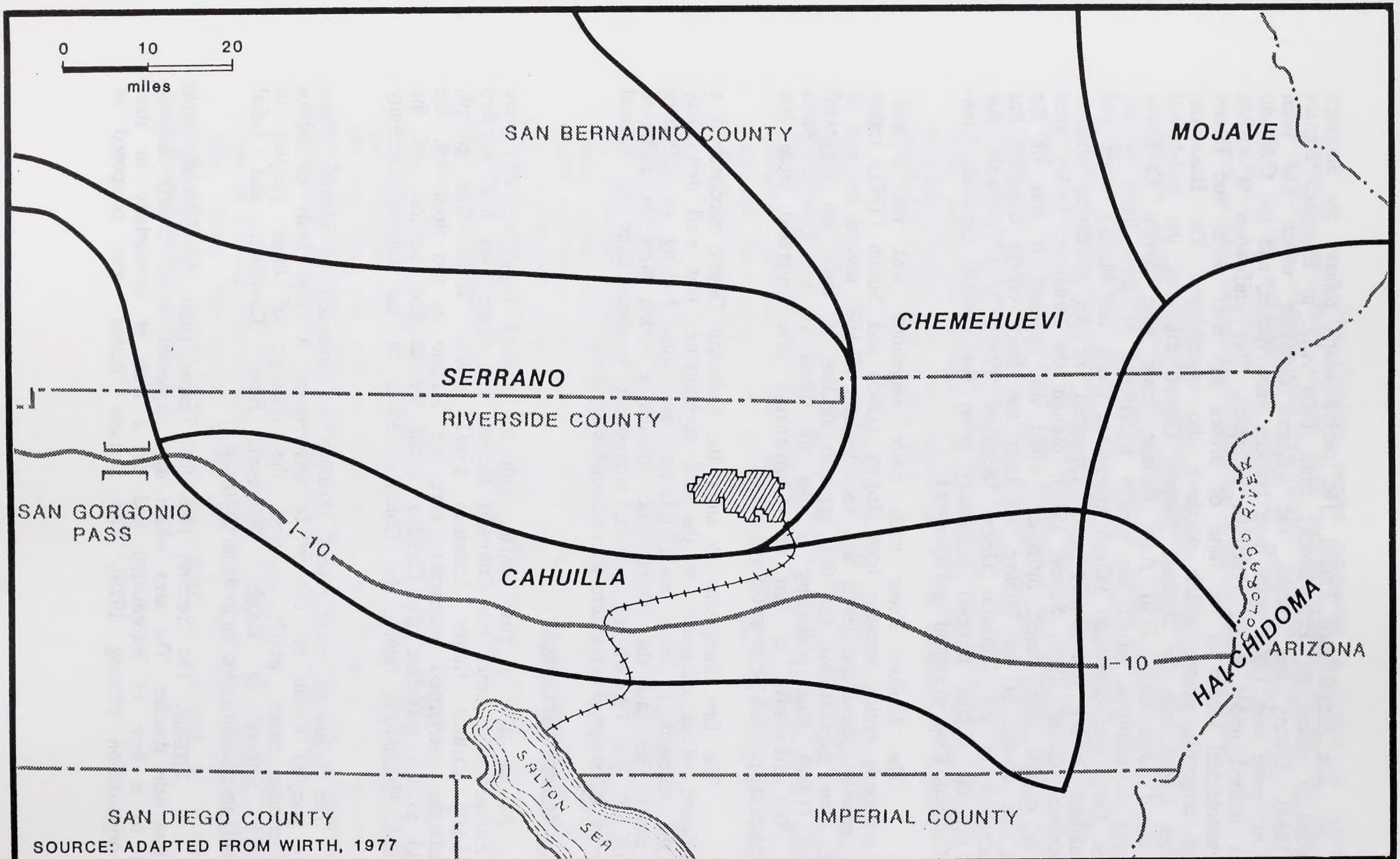
The first Europeans to enter the Colorado Desert encountered a stable population whose adaptation to the arid surroundings was well developed. Although the accounts of these early travelers are often lacking in sufficient detail to clearly delineate the ethnographic boundaries which were in existence at the end of the Protohistoric period, subsequent reconstructions by several scholars portray the situation at that time with acceptable accuracy.

4. Regional Ethnography

At the time of first contact with the Spanish explorers, who were the first Europeans to enter the Colorado Desert, the region was host to five ethnographically distinct Native American tribal groups. These five groups, whose territories overlapped somewhat, were the Serrano in the northwest, the Chemehuevi to the northeast, the Cahuilla across the southern portion, and the Mohave and Halchidoma along the Colorado River at the eastern extremity (Figure 4).

The following ethnographic sketches are intended to identify these five native peoples within the context of this report. A large body of ethnographic literature exists which describes the lifeways of these peoples in detail. Such authors as Kroeber (Mojave), Bean (Cahuilla), and Laird (Chemehuevi) are recommended for in-depth treatment.

a. Serrano. The Serrano take their name from the Spanish word meaning mountain dweller. The area which they exploited is not clearly defined, due both to a lack of information and to a lack of territorially in their political organization (Strong 1929). The Serrano "nation" was composed of



SOURCE: ADAPTED FROM WIRTH, 1977

FIGURE 4. ETHNOGRAPHIC BOUNDARIES AT TIME OF EUROPEAN CONTACT

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independent local lineages, each of which occupied a preferred area, and territorial claims did not extend much beyond this local base. Linguistically, the Serrano dialects may be typed as belonging to the Serran group, Takic subfamily, of the Uto-Aztecan family (Moratto 1984:534).

Overall, the dialectically similar lineages which together made up the Serrano were located from the Cajon Pass on the west to just east of the present-day city of Twenty-Nine Palms and from the desert around Victorville south to today's Interstate 10. This is an area with a great deal of ecological diversity, a fact which forced considerable variability into the Serrano subsistence pattern (Bean and Smith 1978).

The location of Serrano settlements within this overall area were usually determined by the availability of water. Most settlements were in the foothills of the local mountain ranges, although some were situated in the desert near permanent water (Benedict 1924). From these locations, the Serrano carried out a round of hunting and gathering, supplemented to some degree by trade with neighboring lineages (Kroeber 1925).

Individual extended families occupied a rounded, domed dwelling, usually consisting of a willow framework thatched with tule reeds. This was frequently augmented by a wall-less ramada whose shade provided a more pleasant environment for household activity (Drucker 1937). Aside from the individual dwellings, each settlement usually had a ceremonial house, granaries, and a sweathouse. This last structure was located, where possible, next to a pool or stream (Strong 1929).

The Serrano industry utilized shell, wood, bone, stone, and plant fiber to fashion baskets, pottery, stone tools, storage pouches, and a variety of less utilitarian items including musical instruments of several kinds (Bean 1962-1972).

b. <u>Chemehuevi</u>. Of all the ethnographic groups whose territories abutted the survey area, the Chemehuevi are the least documented (King 1975). Originally the Chemehuevi, whose language may be classed as belonging to the Southern group of the Numic subfamily of the Uto-Aztecan family (Moratto 1984:534), resided in the High Desert, and ethnographers have indicated a close relationship with the Southern Paiute (Euler 1966; Heizer 1966). A short time prior to European contact, the Chemehuevi apparently moved into the project area between the Colorado River and the Coachella Valley (Kroeber 1925). After initial contact with the Spanish, the Chemehuevi formed an alliance with the Mojave and evicted the Halchidoma from the Lower Colorado River (Kroeber 1925). Circa 1867, a war erupted between the Mojave and the Chemehuevi, with the result that the Chemehuevi were forced from the lands bordering the Colorado River into the desert. After this defeat, the Chemehuevi tribe became fragmented, some members of the tribe settling around the present site of Twenty-nine Palms, a few taking up residence at Cabazon, and the majority returning piecemeal to the Colorado River area during the following decades (Wirth 1977).

Chemehuevi settlements consisted of groups of related nuclear families, and the size of the village waxed and waned with the seasonal round. The winter season saw the community reach its maximum size, while in the spring, families dispersed over the desert to take advantage of emergent plant growth.

These villages functioned as semipermanent home bases and featured shades, earth houses, and brush dwellings (Laird 1976).

The Chemehuevi subsistence strategy relied upon a seasonal round of hunting and gathering, augmented by agriculture. It has not been established how long the Chemehuevi have practiced agriculture. Laird (1976) indicates that there are no tribal memories of a preagricultural time. Trade probably played a small part of the Chemehuevi economic system (Davis 1961).

No uniquely Chemehuevi industry has been reported. In common with all of the native peoples of the Colorado Desert, at the time of contact they were constructing tools from stone, wood, and bone and producing baskets and pottery. Since the Chemehuevi are relative latecomers to the study area, the development of their culture is not documented in the archaeological record, and much of the technology which they were employing when first contacted seems to have diffused from the Mojave.

c. Mojave. The Mojave occupied the lands along the Colorado River, centered on the Mojave Valley, east of the Colorado River at the latitude of the present-day city of Needles. According to Schroeder (1952), these Yuman-speaking people arrived in the Mojave Valley from the desert to the west around 1150 A.D.

Once in place along the Colorado River, the Mojave developed an economy based on floodplain farming, augmented by gathering, fishing, and occasional hunting. Fishing provided the principal flesh food (Stewart 1983).

Settlement patterns among the Mojave did not include villages, but rather a rural pattern of dwellings in close proximity to arable land prevailed. The houses were occupied only during cold winter weather and were constructed of poles, thatched, and covered with sand and mud (Stewart 1983).

The Mojave culture is distinctly different from that of the majority of the Colorado Desert peoples in one important aspect. While most native peoples felt affinity primarily to their lineage, and secondarily to the area which they inhabited, the Mojave thought of themselves as one nation and relegated both kinship and village membership to secondary status (Kroeber 1976:727). Given this sense of identity, the propensity of the ethnohistoric Mojave for organized warfare becomes more understandable. K. M. Stewart (1947) describes the Mojave preoccupation with warfare as the result of actions by a warrior cult within the tribe and further states that according to his informant, "the people as a whole were pacifically inclined" (Stewart 1947:257).

Mojave technology was strictly utilitarian, with tools fashioned strictly to accomplish the task at hand. Kroeber (1925) attributes this indifference to craftsmanship to the Mojave practice of destroying all of the property of an individual as part of the funeral ceremony.

d. Halchidoma. These Yuman-speaking people occupied the lands along the Colorado River immediately south of Mojave territory and immediately north of that held by the Quechan (Yuma). Their history in the region terminates in 1827-29, when they were defeated by the Mojave and driven eastward from the Colorado River, where they were integrated with the Maricopa. Today, any

Maricopa who makes a claim for a Colorado River ancestry is called Halchidoma (Harwell and Kelley 1983).

Almost no data describes the life-style of the Halchidoma during their tenure in the study area. In all probability, their economy and industry were very similar to both of their river neighbors, consisting of floodplain farming, augmented by fishing and gathering. Also consistent with the pattern, their dwellings would be separated along the river to take advantage of good cropland, rather than concentrated into villages.

e. Cahuilla. The prehistoric territory of the Cahuilla covers the project area's western and southern flanks and extends from the San Bernardino Mountains on the west to the Oricopia Mountains on the east. Great geographic diversity exists within these boundaries, and the Cahuilla adapted to use the resulting diverse environment to advantage. The Cocopa-Maricopa Trail, a major prehistoric and historic trade route, crossed Cahuilla territory.

The language spoken by the Cahuilla belongs to the Cupan group of the Takic subfamily of the Uto-Aztecan family. Other Takic-speaking tribes which interacted with the Cahuilla were the Gabrielino and the Serrano, with whom many common traditions were shared (Bean 1978) and with whom intermarriage and trade were common.

Cahuilla villages were situated to take advantage of the protection from the desert winds provided by alluvial fans and canyons and to allow easy access to water and food sources. From these permanent bases a seasonal round of hunting and collecting could be conducted, and the number of occupants varied with the season. Houses were constructed of desert brush and were variably sized, with the chief's house being noticeably larger and used for ceremonial and recreational purposes. A sweathouse and granaries were also common features of the village (Bean 1972).

The economic system depended heavily on hunting, but the varied ecological zones occupied by the Cahuilla allowed them to develop a utilized flora of several thousand species (Bean and Saubel 1972). Preservation methods for both meat and vegetal material were well developed, and where water was adequate, agriculture was practiced.

Cahuilla industry was similarly varied, with stone, wood, and bone tools, pottery, and basketry all commonly utilized. No forms unique to the Cahuilla, and therefore capable of serving as archaeological markers, are reported (Kroeber 1908).

5. Regional History

Although the Spanish exploration of the American Southwest began prior to 1540, the region surrounding the project area was not penetrated until much later. Fernando de Alarcon may have reached the site of the present-day town of Yuma, Arizona, in 1540 (Bancroft 1886) while exploring the mouth of the Colorado River, but it was not until two centuries later that the Colorado Desert was penetrated by Europeans. In the interim, a party under Juan de Onate traveled down the Colorado River in 1604, and after 1699, Father Eustablio Kino would be established in residence at the junction of the Colorado and Gila

rivers. The area east of the Colorado was regularly traveled during this century, being served by overland routes into what is now Mexico.

The initial European venture into the Colorado Desert was the journey of Father Francisco Garces, who in 1771 made his way from Sonora in Mexico to the San Jacinto Mountains, just west of the present site of the city of Palm Springs. During his journey, he lived among the Yuman-speaking tribes and won their trust, so that he was able to wander freely and receive help in the form of food, shelter, and guides. Upon his return to Sonora, his accounts of his travels were received with enthusiasm, and in 1775, an expedition under Captain Juan Bautista de Anza, guided by Garces, left the presidio of Tubac (Arizona) for the California coast. This party, which originally numbered in all 235 people (Bancroft 1886), reached the mission at San Gabriel on January 4, 1776.

De Anza's route, across the desert and over the San Gorgonio Pass, was made possible by the aid of the native peoples living along the route, from whom he was able to receive needed supplies and advice (Forbes 1964). The success of this expedition led to the establishment of two small settlements on the Colorado, but these were short-lived, being destroyed by the Yuma, who rebelled against Spanish domination in 1781. Father Garces was killed in this uprising, and the overland route to the coastal missions effectively closed (Warren and Roske 1981).

The next chapter in the history of the study area follows a 40-year hiatus. After control of Alta California passed from the Spanish to the Mexican authorities in 1820, interest was rekindled when a group of natives from the Cocomaricopa tribe arrived at San Gabriel and revealed to the Europeans a new route, to be known as the Cocomaricopa Trail. This route, which bisects the project area, originated east of Blythe and generally followed the route of Interstate 10, also crossing the San Gorgonio Pass. The Mexican government dispatched Jose Romero and Jose Estudillo to scout this new trail. Their first attempt, in 1823, failed; but in 1824 they succeeded in reaching the Colorado River at Blythe (Bean and Mason 1964). Mexican authorities concluded that this route was inferior to the more southern Yuma route.

The next trail to cross the Colorado Desert began near the town of Ehrenburg (Arizona) and continued to Los Angeles. Called the Bradshaw Trail after William P. Bradshaw, who opened the route in 1862, it crosses the survey area between Tabeseca Tank and Canyon Spring (Warren and Roske 1981). Frink's route, surveyed in 1855-57 but not opened until 1863, crosses the survey area in three places as it loops north of Desert Center, then south to generally parallel Bradshaw's route.

Between June 1875 and May 1876, U.S. Army Lieutenant Eric Berglund conducted two expeditions to determine the practicality of a proposal to use Colorado River water to irrigate the desert. His routes, from Ehrenburg to Los Angeles in 1875 and from Los Angeles to Ehrenburg in 1876, also crossed the study area (Warren and Roske 1981).

All of the early European incursions into the Colorado Desert shared one common goal: to facilitate transportation from the previously developed areas east of the Colorado to the emerging settlements on the California coast. Whether Spanish, Mexican, or American, these trailblazers regarded the Colorado

Desert as an obstacle rather than an opportunity. Figure 5 depicts the routes which transited the survey area.

With the exception of some very early Spanish efforts near the Colorado River, at the Cargo Muchacho Mountains in 1780-81 (Warren et al. 1981), exploitation of the mineral resources hidden in the mountains surrounding the Colorado Desert did not become an important reason for Europeans to visit this area until well after the country passed into American control in 1848. By 1875, the mountains surrounding the study area were dotted with recognized prospects (Shumway et al. 1980). The earliest of these claims were for gold and silver, but as the United States continued to expand, its burgeoning industries spurred the demand for a host of other minerals, including iron, manganese, copper, fluorite, gypsum, and salt (Warren et al. 1981).

Agricultural exploitation of the desert proper was, and continues to be, thwarted by the lack of water. Adjacent valleys, such as the Coachella, where the water table permitted wells to be dug, developed active farming and ranching communities, and cattle grazed on most of what is today the Imperial Valley. These enterprises were severely limited by the lack of freely available water, as was the case throughout most of California south of the 35th parallel. To cure this deficiency, proposals to tap the flow of the Colorado River had been made as early as 1859, when Dr. Oliver M. Wozencraft contemplated reclamation of the desert by diverting Colorado River water and went so far as to obtain rights from the California legislature (de Stanley 1966). This project was overcome by the Civil War. The U.S. Army, in 1875-76, sent Lt. Eric Berglund to survey possible routes for a canal, but no action resulted from his expedition.

The apparent surplus of water in the Colorado River was widely viewed as the answer to the chronic shortage in southern California, and efforts to match the supply and the demand continued. The initial efforts to divert the river to water the desert occurred in the area just south of the study area, when in 1886, the California Development Company was organized and excavated a canal along the United States-Mexico border. In some places, this canal was constructed on Mexican soil. By 1905, this canal was providing enough water that agriculture could replace cattle grazing in the Imperial Valley, and towns such as El Centro, Calexico, Heber, Brawley, and others were incorporated (Norris and Carrico 1978). But beginning in 1905, a series of natural events abetted by human mismanagement led to the temporary rerouting of the Colorado into the Salton Sink, creating a freshwater lake (Salton Sea) extending over 400 square miles by 1915, when the river was finally rechanneled (Lee 1963).

The demand for fresh water in the Los Angeles area spurred the next canal project, the Los Angeles Aqueduct. Construction of this part-canal, part-pipeline water system was accomplished between 1934 and 1941. Passing directly through the Eagle Mountains, this project had more effect on the study area than any other human endeavor except the mine itself. Beginning at the Parker Dam, water in the aqueduct is propelled by pumping plants which were constructed in the desert at Iron Mountain, Victory Pass, and Hayfield. To power the pumping plants, long-range electrical transmission lines were constructed and camps constructed to house the workers. The remains of electrical substations and camp and service facilities, including a hospital, remain evident adjacent to the project boundary.

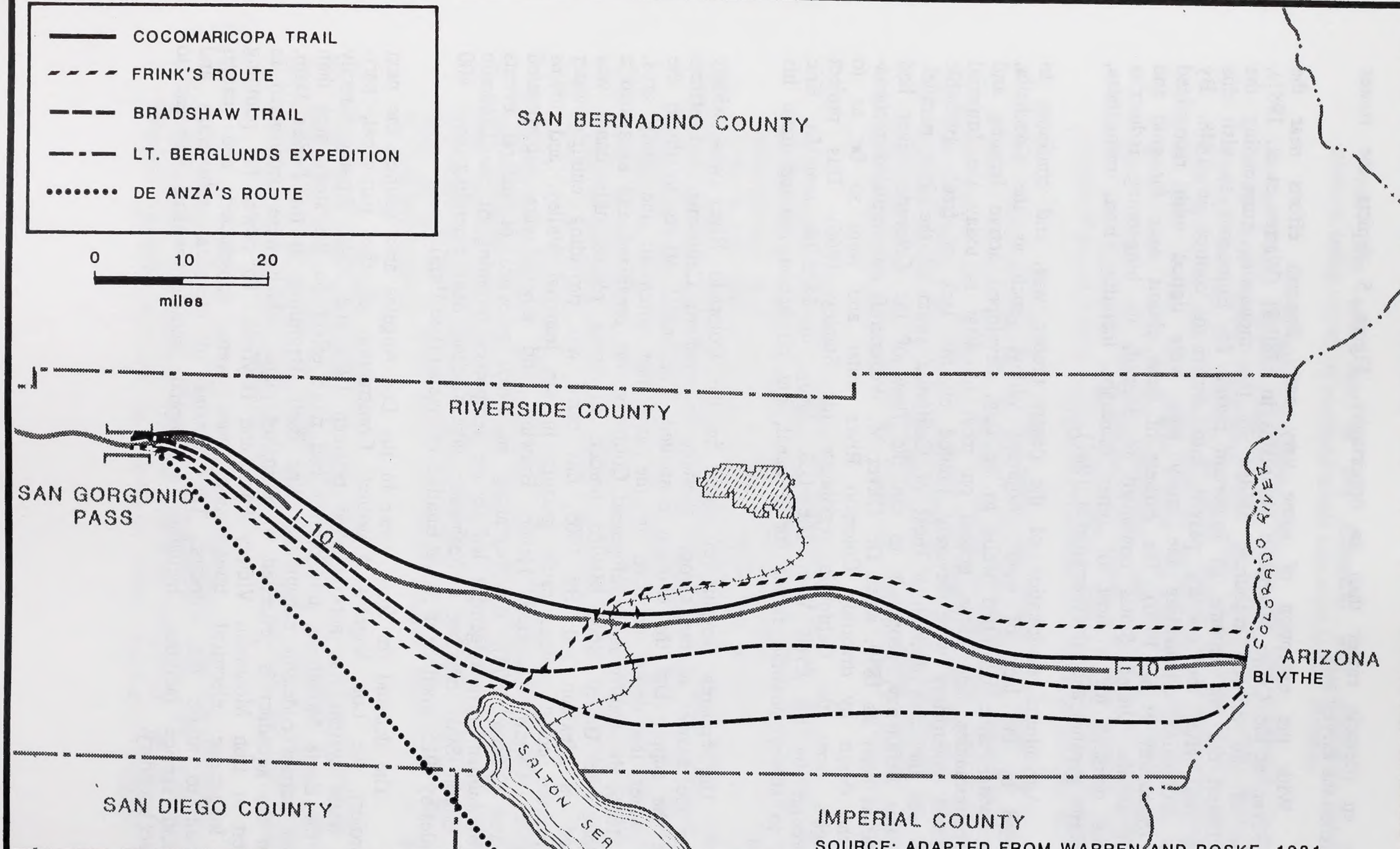


FIGURE 5. DESERT TRANSPORTATION AND COMMUNICATION ROUTES

During World War II, the study area was the home of the Desert Training Center, established by General George Patton in 1942. The center, which originally consisted of over 10,000 square miles, grew with the expanding war effort, until by 1944 it consisted of nearly three times its original size and spilled over into Arizona. By then, the name had been changed to California-Arizona Maneuver Area (CAMA), and over a million troops had participated in the full-scale training maneuvers. This period of history is memorialized at the General Patton Museum at Chiracio Summit, close to the site of Camp Young, one of the many military installations associated with the CAMA (Chiriaco, personal communication, 1989).

Another military activity which marginally affects the study area is the Chocolate Mountains Aerial Gunnery Range, currently used for both air-to-air and air-to-ground weapons training administered through the U.S. Marine Corps Air Station at Yuma. The Kaiser Industrial Railroad passes through the extreme northwest corner of the range, well distant from any of the targets.

This general historical sketch of the region has been necessarily brief, serving to place in perspective the considerations that compelled Europeans to first visit and then develop the Colorado Desert. In chronological order, the historic exploitation of the study area developed from four desires: the desire for an overland route to the Pacific Coast, the desire for mineral wealth, the desire to divert Colorado River water, and the desire to create realistic combat maneuver areas. Since the end of World War II, an additional desire, for space suitable for vehicular recreation, has driven additional development in the study area.

B. PREVIOUS RESEARCH

1. Prehistoric Research Projects in the Survey Area

Prior to the commencement of fieldwork, an archival record search was conducted at the Archaeological Research Unit of the University of California (UC), Riverside. Additional searches were also conducted using RECON's proprietary library and the records held at the Kaiser Eagle Mountain Iron Mine administration building. A copy of the UC Riverside record search is attached to this report.

The results of these searches revealed that only one previously recorded prehistoric site, Riv-3216, was located inside the boundaries of the survey area. This site was originally recorded in May, 1987, and revisited in November, 1987, at which time it was described as a "lithic scatter with several flakes and tools in two loci. Artifacts appear to be washing downhill. Other quartz tool noted previously but not relocated" (see Attachment 1). This site was recorded during a transmission line survey project (Imperial Irrigation District 230-kilovolt transmission line). The survey for that project also located three additional sites within one mile of the current project boundaries, Riv-477, Riv-3217, and Riv-3373.

An additional area of prehistoric cultural activity is the Canyon Spring area, where the railroad passes between the Oricopa Mountains and the Chocolate Mountains. This site, Riv-362, lies approximately one-half mile outside the survey boundaries and consisted of two potsherds when recorded in 1965.

One additional survey within the boundaries of the current project was conducted by the Archaeological Research Unit of UC Riverside on 160 acres immediately east of the East Pit at the Eagle Mountain Iron Mine. This survey found no evidence of cultural activity (Swenson 1978).

2. Summary of Historic Research

From the archival record search, only one area of historic cultural activity has been located within one mile of the boundaries of the project. This site, Riv-1571, is located about 500 meters northwest of the Kaiser industrial railroad just below Canyon Spring. Consisting of two rock walls, a possible tent pad, and a scatter of historic trash which contained no time-diagnostic artifacts, this site had been repeatedly vandalized by 1978, when it was recorded.

The recent history of the area emphasizes three major undertakings which affected the region during the 1930s and 1940s. The first of these, the Los Angeles Aqueduct, resulted in the temporary housing of several thousand workers in the area adjacent to Hayfield Spring. Remnants of their camps are still extant. The second, the California-Arizona Maneuver Area (CAMA), developed under General George S. Patton as a desert warfare training center during World War II, is also still recognizable. Both of these engineering projects, while regionally significant, impinge on the current project area only incidentally and any possible associated remains would be unaffected by the implementation of the project. A subterranean segment of the Aqueduct crosses underneath the Kaiser industrial railroad and the Kaiser truck road in Section 7, Township 4S Range 15E. Nothing identifiable associated with CAMA activity was located during the survey.

The third event is the mining of the iron deposits in the Eagle Mountains and the building of the Kaiser industrial railroad, which is the subject of this report. A number of individuals were helpful in providing information concerning this event.

The absence of formally recorded historic sites was not taken to indicate an absence of historical period cultural activity in the survey area. At the suggestion of Bureau of Land Management personnel, interviews were arranged with Mr. Joseph Chiriaco of Chiriaco Summit and Mr. Stanley Ragsdale of Desert Center. Both of these gentlemen have resided in the area for more than 50 years, and their recollections of activities in the area prior to opening of the Kaiser mine were very helpful. A wealth of information concerning the activities of the mine, including the period prior to the commencement of actual mining operations, was provided by Mr. Orlo Anderson, the mine manager for Kaiser Steel Resources and by Mr. Jerry Stokes, the Kaiser facilities manager.

3. Summary of Ethnographic Research

Since the proposed project crosses lands which were once controlled by currently identifiable groups of Native Americans, definition of the concerns of these Native Americans were of crucial interest. After consultation with Bureau of Land Management (BLM) personnel, an ethnographer whose research among the Native Americans of the area spans more than two decades was selected to solicit input from these Native American groups. The ethnographer is Dr. Lowell

John Bean and he was assisted by Mrs. Sylvia Vane. The results of their inquiries are appended to this report as Attachment 3.

C. HISTORY OF THE KAISER EAGLE MOUNTAIN IRON MINE

The story regarding the discovery of iron in the Eagle Mountains has all the qualities of a frontier legend. The following account is taken verbatim from a story by John Hilton, in the March 1949 issue of *Desert Magazine:*

> Sometime prior to 1881, a prospector named Joe Torres left Needles, California, for a prospecting trip. Joe knew the waterholes so well that he did not follow the established trails, but headed off across country on a fairly direct route to Mecca, prospecting the adjacent mountains as he went along.
>
> As he neared the the east end of the Eagle mountains one afternoon he crossed a ridge covered with huge boulders of iron ore. Joe wasn't interested in iron. He was after gold or silver.
>
> Suddenly the burro balked, with its feet planted on the flat top of a buried mass of iron ore. The animal refused to budge and Joe was puzzled. Jinny had never done this before on the dry hard mesa. She did have a great fear of mud or soft sand along the Colorado river and had given him some trouble in such spots. But here on a dry stretch of desert such obstinacy was beyond understanding. Joe tugged on the rope but Jinny wouldn't move. Then he got behind and pushed and used some language that was not too complimentary, but there was still no action. Jinny just stood rooted to the spot staring at her front feet - picking up first one and then the other and looking at it. Joe got out his prospecting pick and struck the black rock that seemed to be puzzling his traveling companion. It was hard and tough, but a few chips broke off. Amazingly, the fragments, instead of flying away as they should, were drawn back to the mother rock and stuck there. The rock was magnetic! The burro had iron shoes and there was a sticky feel under her feet which had her puzzled and frightened.
>
> Joe found that his pick would stick to the rock. Here was a curiosity that he should take with him to civilization, otherwise, no one would ever believe his story. The rock under Jinny was too big to take away so he began looking about him. He learned that although the black boulders looked alike, they were not all magnetic. It was some time before he located a piece which would attract his pick and was small enough for him to handle. Jinny, her curiosity finally satisfied, had meandered off and was contentedly munching a bunch of galletta grass.
>
> Several days later Joe and Jinny halted in front of the general store in Mecca and Joe unlashed a heavy black rock from his pack and stumbled up the steps with it. Jinny sighed with relief. Her curiosity had certainly increased her burden! Joe traded the curio to the storekeeper for some grub and the stone with nails and other metal objects clinging to it, rested on the store counter for many years.

Although Joe Torres was indisputably the first to make note of the magnetite deposit, he filed no claims. This was not the case with the next individual who encountered these resources.

Jack Moore left Banning on a prospecting trip in the fall of 1881, arriving in the Eagle Mountains by a circuitous route. On the first of November, he staked a claim on the iron deposit and returned with samples. Moore filed additional claims for gold and silver, recording these as well as the iron claim on December 1, 1881, and January 3, 1882. With his father and two others as partners, they organized the Eagle Mountain Mining District. But the group failed to keep up the assessment work necessary to validate their claim, and a new claim on the deposit of iron was filed by L. S. Barnes of Mecca, California.

Barnes had studied at the Colorado School of Mines and recognized the richness of the deposit from the original Torres' sample at the Mecca general store. He relocated the older Moore claims, determined that they had lapsed, and in 1895, began a process of consolidating the claims under his control. By 1912, Barnes had completed the project, and the next legend concerning the Eagle Mountain Iron Mine was about to be born.

Barnes' plan was to sell the consolidated claims on the ore to Henry E. Harriman, chief executive officer of the Southern Pacific Railroad. Harriman, despite his primacy in the railroad business, was at the mercy of the Steel Trust, led by J. P. Morgan's U.S. Steel. Barnes felt that by gaining ownership of the Eagle Mountain iron deposits, Harriman could use the threat of building his own steel industry on the West Coast as a lever to bring down the price the eastern steel interests were charging his railroad for rails. Harriman, according to the story, saw the worth of Barnes' idea and wrote him a check for the full asking price of $1,512,000 on the spot.

Whether Harriman felt that the idea of a West Coast steel industry was feasible or whether he was running a gigantic bluff is not recorded. But he did buy a steel mill site in San Pedro, California, and caused a rail spur to be surveyed. And the price charged to the Southern Pacific for rail by the eastern steel companies dropped dramatically. Harriman died before revealing his true intentions, and no action to develop the iron deposits was taken until World War II sparked the demand for steel in huge amounts (Hilton 1949; Belden 1964a).

During this period, the Joshua Tree National Monument was created and at first included the Eagle Mountain ore deposits. Within the confines of the monument, mining was forbidden.

At this point, Henry J. Kaiser entered the picture. Kaiser, initially a road contractor but more recently a member of the construction consortium which had built the Hoover and Bonneville dams, was building ships for the Navy and Merchant Marine on the West Coast. He needed steel. Already the owner of a steel mill at Fontana and iron ore from the Vulcan mine near Kelso in the Mojave Desert, he was able to convince the Harriman heirs to sell the Eagle Mountain claims. But there was one condition insisted upon by the heirs. All of the ore from the mine had to be shipped over the Southern Pacific Railroad.

This left Kaiser with two problems: he owned rights to a deposit of ore that he was not legally able to mine and he was required to move the ore over a

railroad some miles away from the mine. A third problem temporarily surfaced when Harlan Bradt revealed that he held leases to some of the deposits. After a legal struggle, Kaiser attorneys succeeded in having Bradt's claims dismissed, leaving only the problem of the mining prohibition and the railroad.

Kaiser solved the prohibition problem by exerting sufficient political force to have the monument boundaries adjusted to meet his needs. Also, he decided to build a railroad of his own to connect with the Southern Pacific (Belden 1964b).

This work commenced in 1944, with surveyors identifying three possible routes. The first of these went over Shaver's (now Chiriaco) Summit to Indio, the second went down Box Canyon to Mecca, and the third down Salton (or Salt) Creek wash to meet the Southern Pacific at Duramid. The choice was determined by the need to limit the maximum grade with which the ore trains would have to contend to two degrees. This criteria favored the Salton Creek wash route, and after some difficulties in obtaining the right-of-way from the owners, construction began in August of 1947. The Kaiser Industrial Railroad was completed on June 23, 1948 (Backman 1949) and began regular ore shipments to the Fontana, California, mill.

With all of the elements in place, the mining operations continued to develop, and by 1971, the Eagle Mountain Iron Mine was the principal source of iron ore in California and accounted for over 90 percent of the state's iron production (Bureau of Mines 1971).

After 35 years of operations, changing economic conditions forced the suspension of mining activity in November 1982, and shipping ceased in April 1983 (Anderson, personal communication 1989). During the time that active ore extraction was ongoing, the Kaiser Eagle Mountain Iron Mine was the largest single private employer in Riverside County, with a work force of over 4,000.

Caring for this emerging community led to the construction of a company town at the mine site, with houses built by Kaiser and rented to the employees. Schools, fire, police, and recreation facilities were all established, and before cessation of mining operations, accommodations available in the town at the mine consisted of 416 houses, 185 trailer spaces, 383 dormitory rooms, and 32 apartments (Kaiser Steel Corporation 1981).

The decline from this peak of activity was rapid. By the end of 1983, only three employees remained at the mine site. Many of the houses had been purchased by outsiders and relocated, and others were left vacant, inviting vandalism. Gradually, the company increased the security and maintenance work force, which stands at over 20 individuals today (Stokes 1989). The school remains open, serving the surrounding region.

A privately run, low-security penal institution, the Eagle Mountain Return-to-Custody Facility, currently leases a portion of the town area, where it houses parole offenders. A few houses are rented to individuals who work in Desert Center and other neighboring communities.

III. FIELD INVESTIGATIONS

A. SURVEY CRITERIA

The objective of the survey was to provide a complete inventory of the cultural resources located within the boundaries of the project area. Where cultural resources were located, they were to be evaluated to determine their eligibility for the National Register of Historic Places.

1. Prehistoric Cultural Resources

Prehistoric cultural resources, at their most basic, consist of the artifacts and features which are the material remains of the Native American peoples who exploited the survey area prior to contact with the Europeans. Artifacts and features may occur in groups or as single occurrences. Groups of artifacts which are presumably related to each other and are found in surface densities equaling three items within a 25-meter radius or greater are generally recorded as sites, while artifacts found in surface densities less than three per 25-meter radius are recorded as isolates. Features are usually recorded as sites even though they occur singly. Cultural resources, either sites or isolates, must be recorded with the appropriate clearinghouse even if they fail to meet the stringent National Register criteria. All prehistoric cultural resources (sites and isolates) discovered during the survey were recorded.

2. Historic Cultural Resources

The material remnants of past lifeways are valuable to complete the picture of activity in the survey area even where a written record is available. As discussed in the Cultural Background section of this report, the historic period in the Colorado Desert is largely unwritten. Archaeological investigations are the principal remaining data source to bridge this gap in the historical record.

Placing a dividing line between what is or is not "historic" is an admittedly arbitrary procedure. For the purpose of this survey, the year 1939 was selected, for two reasons. First, anything demonstrably later than 1939 would be subject to more stringent eligibility rules for inclusion in the National Register solely due to being less than 50 years old, and second, the Eagle Mountain Mine and Kaiser industrial railroad, as industrial entities, are more recent than 1939. Since the mine and railroad both exemplify modern industrial technology, have been continuously modified, and were fully functional when idled by economic considerations, classifying such a complex or portions of it as "historic" is not expressly within the National Register criteria.

B. SURVEY METHODOLOGY

The Specific Plan area encompasses 4,659 acres at the Eagle Mountain Mine, much of which has been badly disturbed by past mining activities. The disturbance is so pervasive that any cultural resources which may have once existed on this portion of the property have been either carried away with the ore or covered by tailings piles, which in some instances are hundreds of feet thick. These disturbed areas were omitted from the survey.

In addition to the area surrounding the mine itself, 1,500 acres of sectioned land adjacent to the Kaiser Industrial Rail Road, a 200-foot-wide corridor along the 52 mile length of the railroad, and a 200-foot-wide corridor along the Kaiser Truck Road were also surveyed.

The topography varies from level, open desert to mountain slopes in excess of 100 percent. Given this diversity of terrain, it would not be reasonable or even possible to subject all parts of the project area to the standard archaeological survey pattern of parallel transects at a predetermined spacing. The undisturbed areas fall into three categories:

1. Mountain slopes, ridges, and intermontane saddles.

2. Relatively open, level desert.

3. Rail and road right-of-way.

For each of the above area types, different survey methods were employed:

1. <u>Mountain Slopes, Ridges, and Saddles</u>

Of the three types of terrain, the mountains and connecting saddles were the most difficult areas in which to maintain survey integrity. Access by even four-wheel-drive vehicles was denied by the deliberate placement of tailings piles across the mouth of every drainage. This barricade policy was instituted by the Kaiser Iron Mine to prevent access to these areas by mine workers (Stokes 1989), and the barriers work well. In order to reach the areas unscarred by mining activity, RECON survey crews usually found it necessary to climb the ridge face, traverse the spine, and then descend into the adjacent valley. While climbing, the survey teams were alert to detect the residue of prehistoric quarrying, as well as examining natural niches and overhangs for evidence of the type of caches which have been found in somewhat similar terrain to the west. The steepness of the terrain and the absence of water argue that any use of these mountains by aboriginal peoples must have been temporary, and expectations were that if prehistoric artifacts were discovered, they would be indicators of transhumance.

If the expectation of finding evidence of prehistoric activity on the slopes was low, this was counterbalanced by high hopes of locating evidence of the early historic mining period (prior to 1940). The entire surface of the project area is covered with cairns and posts which mark the various claims which have mostly passed into Kaiser Steel ownership over the years. The typical claim marker consists of a rock cairn one to two feet high, which supports a four-by-four timber some three to four feet high. The post is topped by a copy of the claim notice folded into a screw-top jar and secured to the top of the four-by-four. Exposure to sunlight over the years has rendered the claim notice forms so brittle that unfolding the paper in order to determine the age and ownership of the claim was not possible without destroying the document in the process. Apart from these claim markers, only modern litter remains to indicate that these steep slopes are ever visited.

The ridge tops were searched along their length, with special attention being given to possible rock alignments which may have been created by

human activity. Also, the game trails, which from the evidence of droppings were created and are still frequented by bighorn sheep, were given special scrutiny for evidence of Native American use.

In several instances, relatively level saddles connect two adjacent peaks within a ridge system. These saddles are effectively shielded from the persistent winds and provide a location suitable for a comfortable dry camp. Each saddle was carefully checked for any evidence of such activity, either prehistoric or historic.

At the base of the steeper ridges, narrow drainages serve to rapidly remove the scant precipitation that does fall on the project area. Even though the project had received a substantial rain less than three weeks before the survey, no standing water was observed. Nonetheless, each of these drainages was examined for signs of cultural activity.

Archaeological visibility on this type of terrain is unparalleled. There is literally no soil cover, and the vegetation is accordingly sparse. The natural surface of the rock is patinated to a dark reddish brown, and flake scars, whether natural or man-made, stand out clearly. Modern trash, such as beer and soda cans and paper food wrappers, is easily detected at ranges measured in tens of meters. Any anomaly caused by cultural activity would be immediately apparent. The absence of cultural material reported by the survey party can be taken with confidence as a valid representation of an apparent absence of cultural activity within the project area. Specifically the absence of cultural activity which produces archaeologically discernable by-products.

2. Open, Level Desert

This type of terrain was located in two areas within the larger project area. Most of the land scheduled to be transferred to the BLM as part of the project falls into this category; as does the area at the mine along the eastern project border. Here the landform is such that a parallel transect approach is appropriate and effective. The survey crew, operating in teams of two to four people, walked approximately 15 to 20 meters apart over the parcel.

Archaeological visibility in these areas was excellent, though anomalies, whether artifacts or modern litter, were not so obvious as in the mountains. The vegetation is typical of the Lower Sonoran community, with occasional palo verde rising 15 to 20 feet above the sparse creosote scrub. Survey team members had no difficulty maintaining orientation throughout each transect, easily keeping the other team members in sight. When necessary to give an area a stricter scrutiny, the entire team stopped until all were ready to proceed.

Expectations for the desert areas were fairly high, as this type of topography was the least disturbed of any encountered within the project boundaries. That more remnants of cultural activity were not located in these areas can be explained best in terms of transitory, ephemeral use by both prehistoric and historic period desert travelers. Given the arid conditions and lack of exploitable resources, habitation sites are unlikely. Since the surveyed parcels did not include any areas where water was reliably available, with the

exception of the Salt Creek and Hunter's Spring drainages, the lack of sites is somewhat understandable.

Can and bottle remnants are found scattered over the surface everywhere. Most cans and bottles are obviously modern litter and appear to have been transported to the area for the purpose of target practice. Some isolated bottles and cans may be considerably older, but no cans or bottles that were demonstrably older than circa 1950 were identified within the parcels surveyed.

3. Rail and Road Ways

The right-of-way for the Kaiser Industrial Railroad has its southern terminus at Ferrum, on the northeast shore of the Salton Sea, where it joins the Southern Pacific. From this point the line trends northeast through the pass between the Oricopa and Chocolate mountains, turns northward to pass between the Oricopa and Chuckwalla mountains, and then resumes its northeast direction after crossing Interstate 10. Skirting the eastern flank of the Eagle Mountains, the orientation of the right-of-way slowly backs around to the northwest as it approaches the mine. The 2 percent limitation on grade imposed by the fundamental design of railways ensures that, for all of its 52-mile length, the terrain within the 200' survey corridor will be essentially level.

Construction of the roadbeds entailed scraping away the natural soil for at least 20 meters on either side of the edge of the road and/or rail line (Backman 1949). The undisturbed portion of the 200-foot- (61-meter-) wide survey corridor through which the Kaiser Industrial Railroad passes is reduced by this disturbance, as well as by the nearly 10 meters occupied by the track bed itself, to a strip less than five meters wide on each side of the tracks. This severe and ongoing degradation of the natural land surface has been further aggravated by the jeep trails which have been created by railway maintenance crews and private off-road vehicles. These trails, which allow access to the railway and adjacent lands, are marked by the deposit of modern litter along their margins.

The description of the condition of the rail line applies equally to the right-of-way for the Kaiser Truck Road, with the additional disruptive factor of a parallel electric power line. The truck road was at one time paved along its entire five-mile length, but the cumulative effects of the environment and the lack of maintenance have reduced the southern two miles to a rough track, and the connection, just south of Victory Pass, with Eagle Mountain Road has been deliberately severed and blocked.

Because the Kaiser Truck Road is tentatively scheduled for realignment, the survey area was enlarged to include the area through which it might be rerouted.

To survey these rail and road rights-of-way, the archaeological field crew was divided into two-person teams, one on each side of the centerline, in the center of the lesser disturbed area which fringes the right-of-way. One team would commence and the other team would drive the vehicle ahead for a specified distance, usually two miles. Two miles were selected as the estimated distance that a survey team could cover in one hour. The second team would then park the vehicle and survey in the same direction as the first team. When the first team reached the vehicle, they would move it forward an

additional two miles; thus, the two teams would leapfrog along the right-of-way. This method was selected as the most efficient use of assets, since it minimizes overlap and dead time while ensuring 100 percent coverage.

The width of the undisturbed strip alongside the road and rail ways averaged less than five meters, and there were no adverse environmental conditions which would have obscured artifacts or features from view.

IV. SURVEY RESULTS AND ANALYSIS

A. SURVEY RESULTS

The results of the survey verified that very little evidence can be found to support any contention of intensive exploitation of the project area by either Native Americans or settlers prior to 1940. There is always the possibility that such exploitation occurred and that the evidence has been subsequently erased by either natural forces or post-1940 human activity or both, but this is not felt to be probable. That this area was visited on an intermittent basis by both Native Americans and Europeans prior to 1940 is without a doubt the case, however the paucity of material remains testify to the brevity of such incursions.

1. Eagle Mountain Iron Mine Including BLM Exchange Lands

No evidence of prehistoric cultural activity was discovered by the survey team either within the Eagle Mountain Mine area or within the BLM exchange lands area. Pre-1940 cultural activity was undoubtedly present, but the degradation of the natural landscape, which is the natural consequence of open pit mining techniques, is so extensive that no evidence survives. This is known to have occurred in the case of Briest's camp, a miner's camp dating from the 1920s, which is now covered by tailings pile T-6 (Stokes, personal communication, 1989; Ragsdale, personal communication, 1989). Ragsdale remembers additional small mining camps in the vicinity of the Eagle Mountain mine, but none located within the project area. Most of the independent mining activity appears to have been west of the current project boundaries, in the vicinity of the Black Eagle and Iron Chief mines. Stokes confirmed this, adding that some remnants of these early mining camps are still evident.

2. Kaiser Exchange Lands

The parcels of land along the rail right-of-way which are scheduled to be transferred to BLM jurisdiction, were, with the exception of nine isolated artifacts, devoid of evidence of prehistoric activity. Three of the five isolates are individual flakes found in the surveyed portion of Section 21, Township 6 South, Range 14 East, about three miles south of Interstate 10. The fourth was a single flake found in Section 20, Township 8 South, Range 11 East. Four additional flakes were located in Sections 8 (Township 6 South Ranch 14 East), Section 13 (Township 7 South Range 13 East), Section 22 (Township 13 South Range 11 East) and Section 33 (Township 6 South Range 14 East). The remaining isolated artifact is a single sherd of Native American pottery, found in the approximate center of Section 27, Township 5 South, Range 14 East, in a wash descending from Difficult Canyon. These isolated artifacts have been recorded with the clearinghouse at the Archaeological Research Unit, UC Riverside (see Attachment 2).

The same area, Section 27, also contains a trash scatter of possible pre-1940 origin, located some 30 meters northeast of the site where the sherd was found, on the margin of the same wash. Three bottle fragments of purple glass were located in Section 27 just south of the railroad.

No other cultural materials other than obviously modern litter were located on any of the other exchange parcels.

3. <u>Road and Rail Ways</u>

The record search (see Attachment 1) indicated that Riv-3216 was located inside the corridor to be surveyed; however, this site was not relocated despite a careful search of the described location. The failure to relocate Riv-3216 is surprising in two regards: first, visibility in the area is excellent, and second, the description of the locational reference landmarks which are readily apparent. Nonetheless, there is no deposit of cultural material within the 200-foot right-of-way at the intersection of the rail line and the Imperial Irrigation District 230-kilovolt power line. The site record filed by D. Pinto of the Archaeological Research Unit at UC Riverside indicates that the "artifacts appear to be washing downhill," and it is possible that the two additional rainy seasons which have passed since Pinto's survey have resulted in further migration of the material which she located, to the area outside the narrow confines of the present survey corridor.

Close to the reported location of Riv-3216 there is a previously unrecorded locus of prehistoric cultural material, consisting of both chipped and ground stone artifacts and pottery sherds. This site, recorded as Riv-3798, is located 600 meters southwest of (and uphill from) the mapped position of Riv-3216. A site record form (DPR-422) for this site has been filed with the Archaeological Research Unit at UC Riverside (see Attachment 2). One hundred thirty-seven identified surface artifacts, consisting of Native American pottery sherds, stone tools, and lithic debitage, were mapped in situ (Figure 6).

What currently exists of the site is located on two sides of a railroad cut which has removed the center of the site. The railroad tracks and associated debris resulting from periodic repair (railroad ties, metal stakes, and metal) lie at the base of the 10-meter cut. A 3 to 5-meter high and 8-meter wide excavation backdirt pile of pink clay subsoil lies 6 meters southeast and paralleled to the southeast edge of the railroad cut. The eroded remains of a road track are located 14 meters from the edge of the northwest slope.

The 137 mapped surface artifacts were located on either side of the railroad cut, from the edge of the top of the cut to a distance of approximately 40 meters on the northwest and 23 meters on the southeast (see Figure 6). The mapped surface artifacts within this area were collected at the time of the initial survey. Field archaeologists felt the collection of this material was appropriate because the land was considered to be privately owned. Because of the mixed land ownership patterns of the area, it was not realized at the time of the survey and collection that the site was located on federal land and would require consideration under the Section 106 consultation process. A controlled surface collection was conducted. Each of the 48 surface plots references one individual lithic artifact or cluster of from 2 to 9 potsherds. A catalog of the recovered material and associated computer analysis sheets are included in Attachment 4. During the visits to the site, additional cultural materials were

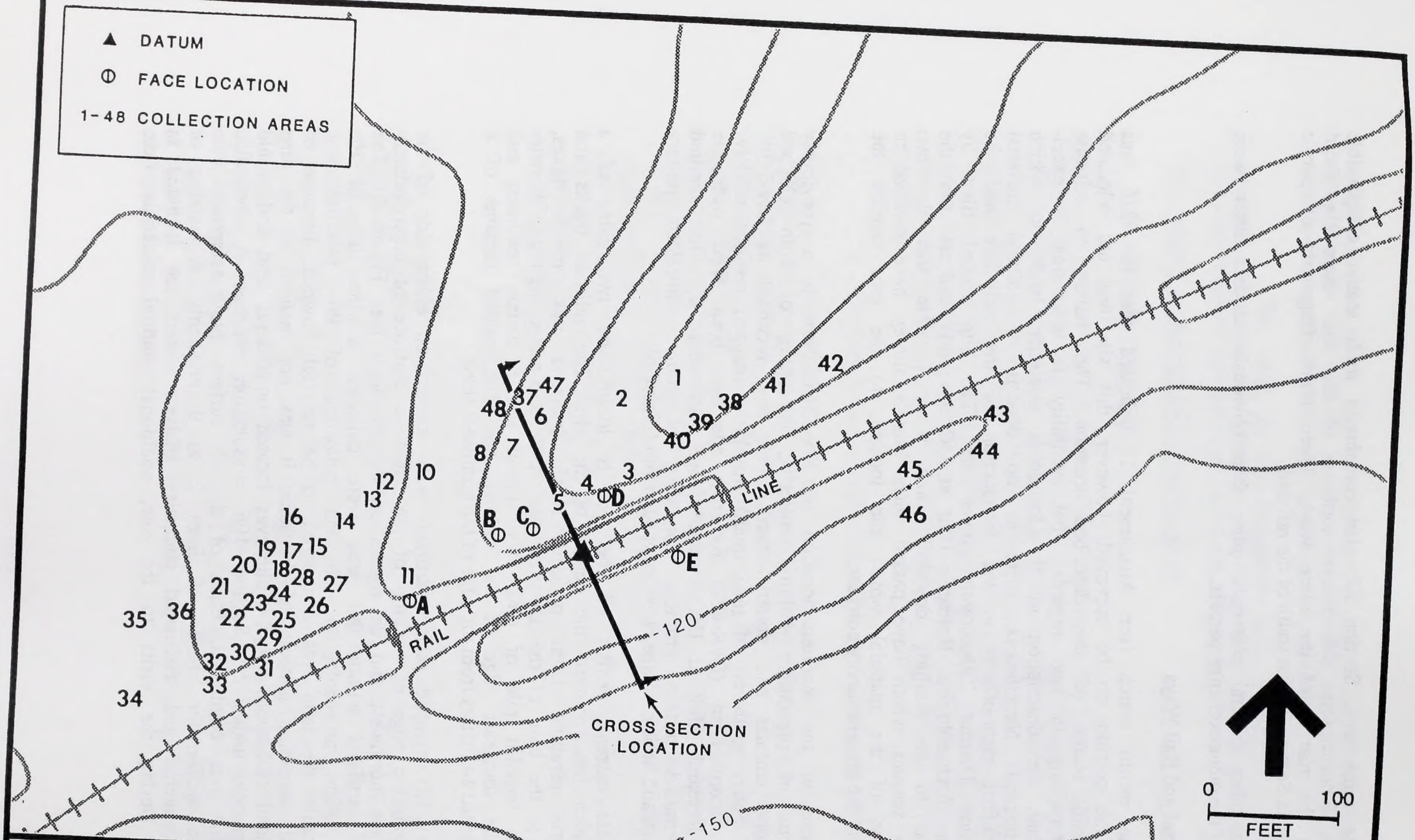


FIGURE 6. Riv-3798 SITE MAP

observed at a distance of approximately 45 meters to the southeast on the far side of the backdirt pile which resulted from the excavation of the railroad cut.

A subsequent field visit to the site was conducted to obtain additional documentation regarding the nature of the stratigraphy at the site and to assess the potential for additional surface or subsurface cultural materials. A cross-section portraying the extent of the road erosion, railroad cut, and the backdirt pile, was reconstructed using transit and stadia rod (Figure 7). At five locations along the railroad cut slope (four on the northwest slope and one on the southeast slope), a clean face was cut to provide a detailed profile of the stratigraphy. This approach was discussed with Garth Portillo of the BLM Riverside office prior to the field visit. The locations of the faces are shown in Figure 6.

The soil profile observed in face D is shown in Figure 8. The four profiles observed in the northwest faces showed remarkable similarity in strata. The top stratum consists of a layer of sandy topsoil. As would be expected in a deflationary situation, this layer is progressively thinner as the top of the knoll is approached. The topsoil stratum is approximately 2 centimeters thick in face D (at the top of the knoll), and approximately 20 centimeters thick in face A (approximately 150 feet from the toe of the knoll slope). One potsherd was found in the topsoil stratum at face D, within two centimeters of the surface.

As can be seen in Figure 8, the remaining strata (from the surface to approximately 44 centimeters below the surface) consist of reddish/brown clayey sand, fine gray sand, coarse gray sand and small angular stone, fine gray sand, fine reddish brown sand, and fine dark gray sand. These observed soil strata reflect the lakebed depositional origins of the area. They extend to within 2 centimeters of the surface, and represent an absolute limit to the potential extent of any cultural materials.

The remaining face (E) was cut on the southeast slope. This area has been additionally disturbed by extensive erosion caused by the runoff from the backdirt pile of pink clay subsoil just to the southeast. The top 20 centimeters of this face consisted of the redeposited pink clay subsoil, the remaining 40 centimeters consisted of a grey/brown sterile sand.

A thorough resurvey of the site area (approximately 75 meters to the northwest and southeast of the railroad tracks, approximately 300 meters to the northeast of the site datum and approximately 120 meters to the toe of the knoll slope on the southwest) was conducted. Two additional potsherds and two flakes were observed within the previous surface collection area north of the railroad tracks. A widely dispersed scatter of potsherds was observed on the southeast side of the pink clay backdirt pile. This scatter has been heavily impacted by erosion caused by the runoff from the backdirt pile.

One additional disturbance factor at the site is the erosion down the slopes of the knoll which has been intensified by the railroad cut excavation, the placement of the backdirt pile, and an old road north of the railroad cut. The site revisit was conducted within four days of heavy rains which caused Salt Creek to wash out the access road which leads to the site. Additional erosional rills and cuts at the edge of the railroad cut along the road

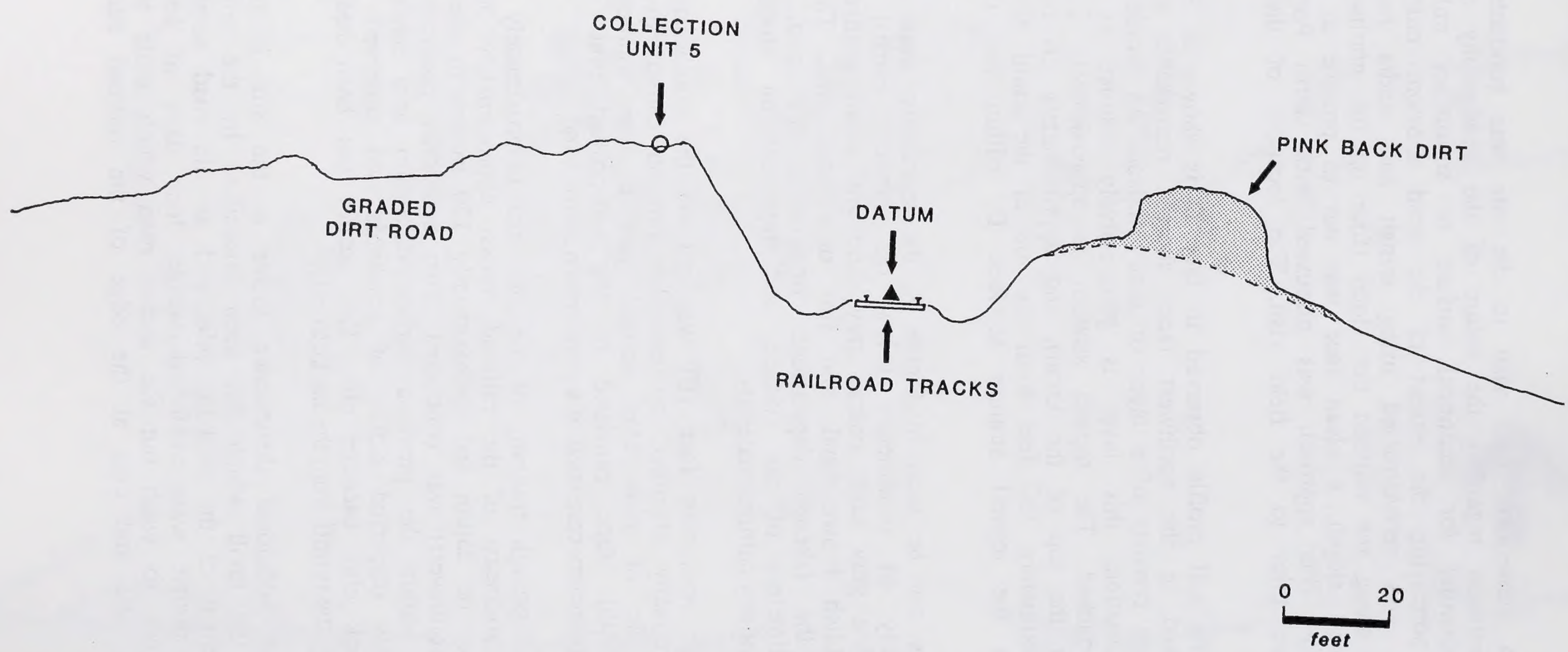


FIGURE 7. Riv-3798: CROSS SECTION OF RAILROAD CUT

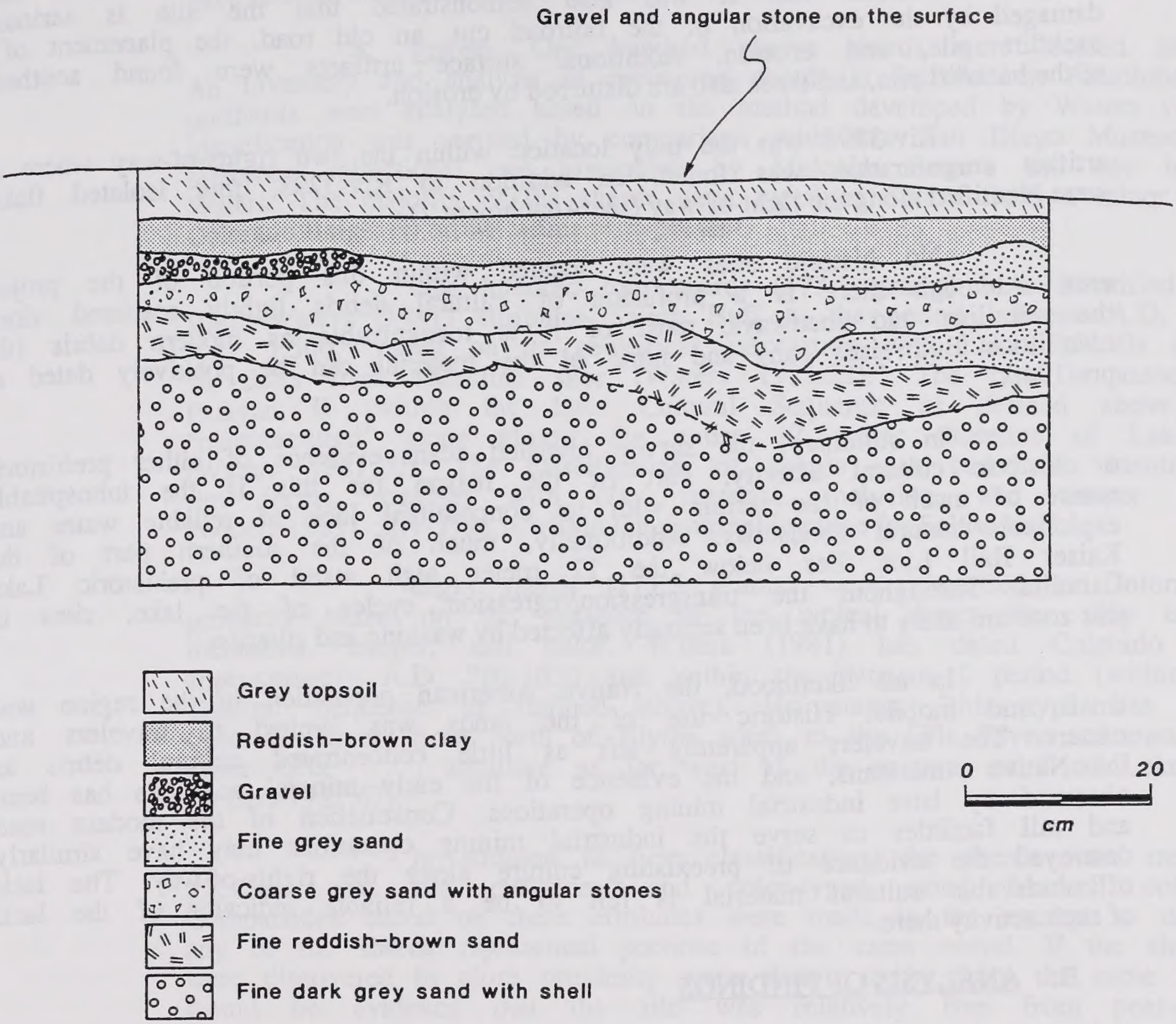


FIGURE 8. Riv-3798: PROFILE OF FACE D

remains northwest of the railroad cut, and on the northwest and southeast slopes of the backdirt pile and adjacent land surface were observed.

As a result of the initial survey activities and the subsequent site documentation visit, it was demonstrated that no subsurface site remains exist along the railroad cut. It was also demonstrated that the site is seriously damaged by the excavation of the railroad cut, an old road, the placement of a backdirt pile, and erosion. Additional surface artifacts were found southeast of the backdirt pile, and these also are disturbed by erosion.

Riv-3798 was the only location within the two rights-of-way where an artifact concentration was found. In addition to Riv-3798, four isolated flakes were identified along the right-of-way (see Attachment 2).

No historic sites were located within this portion of the project area. Although there is a profusion of cultural debris lightly scattered along the rail line and roadways, most of it is recognizable as modern debris (the ubiquitous Budweiser can) and none of the material can be positively dated as pre-1940.

In summary, the survey revealed scant evidence of either prehistoric or historic cultural activity. Part of the reason for this is the inhospitable nature of much of the terrain with its concomitant lack of reliable water and exploitable natural foodstuffs. Additionally, much of the southern part of the Kaiser Rail Line lies below the 12 meter high stand of prehistoric Lake Cahuilla. Throughout the transgression/regression cycles of the lake, sites in this zone are likely to have been seriously affected by washing and siltation.

In all likelihood, the Native American population in the region was small and mobile. Historic use of the lands was limited to travelers and miners. The travelers apparently left as little concentrated cultural debris as the Native Americans, and the evidence of the early miners' activities has been obscured by later industrial mining operations. Construction of the modern road and rail facilities to serve the industrial mining operations may have similarly destroyed the evidence of preexisting culture along the rights-of-way. The lack of observable cultural material is felt to be a reliable indicator of the lack of such activity there.

B. ANALYSIS OF FINDINGS

1. Riv-3798

As described above, the site is bisected by the Kaiser railroad cut which, along with an old road, a backdirt pile, and erosion, constitutes a major disturbance to the resource, compromising its research potential.

The site was shown to consist of surface artifacts only. This was confirmed through documentation of faced profiles of the railroad cut. There is no evidence that subsurface remains exist at the site.

The overall impression of this site is that the assemblage represents a disrupted remnant of a temporary camp, probably occupied briefly by a hunting and gathering party, possibly during the Protohistoric (Moratto 1984:424-430) period as defined in the Cultural Background section of this

report. The relative profusion of pottery in the assemblage justifies th temporal assignment. The portable milling equipment (mano and metate) and t presence of both hunting and processing lithic tools contribute to the asses ment. The area close to the site is marked on the USGS map as a seep, a although the survey party did not see any signs of surface water, the seep m have been an exploitable water source in past times.

a. Pottery. One hundred twelve sherds were located at the si An inventory and analysis of recovered sherds is included in Attachment 4. T potsherds were analyzed based on the method developed by Waters (1981). T identification was verified by comparison with two San Diego Museum of M reference collections: one assembled by Malcolm Rogers and one by Micha Waters. The majority of the sherds were typed as Salton Buff, a minor amount Colorado Beige; no brown wares were present.

One hundred four sherds (773.1 grams) were identified as Salt Buff. Waters (1981) attributes Salton Buff to the period between A.D. 1,000 a A.D. 1,500, "based on its geological association with Lake Cahuilla and carb 14 dates from shoreline sites (Waters 1981:22)." The type is associated wi Patayan II (within the Late Cultural Sequence as defined above). It w "manufactured" along almost the entire 12 meter shoreline of Lake Cahui (Waters 1981:20). The classification of sherds was based on identification rim forms, together with clay material, inclusion, and temper constituen (Waters 1981). Riv-3798 is within the geographic range for Salton buff.

Eight sherds (171.5 grams) were identified as Colorado Beig primarily based on the presence of the typical direct rim, clay compositio inclusions, temper, and color. Waters (1981) has dated Colorado Beige approximately A.D. 700-1050 and within the Patayan I period (within the La Cultural Sequence as defined above). He states, "this type lies along t Colorado River, from north of Blythe south to the Gila River and east along t lower Gila . . . intrusive as far west as the eastern stand of Lake Cahuill (Waters 1981:67).

In addition to type classification, the sherds were measured f thickness and rim curvature, and color-typed using Munsell color char Comparisons based on these attributes were made in the attempt to determine any of the sherds represented portions of the same vessel. If the sherds whi were discovered in close proximity were shown to be from the same vessel, th would be evidence that the site was relatively free from post-depositior disturbance. Unfortunately, this was not the case, and no relationships cou be demonstrated by this method. Six (5 percent) displayed evidence of conta with fire. Thicknesses ranged from 2 mm to 9 mm. None of the pottery w decorated.

Nineteen sherds (17 percent) were rim fragments. Vessel forr were projected based on the form of the rim sherds (see Attachment 4). T vessel forms were projected based on a method described in Wade (1985). For names are based on those first described by Rogers (1936) and expanded upon Waters (1981). Vessel forms represented included: seven bowl rims (radi average 11.5 centimeters), two pot rims (one radius of 9 centimeters and o undeterminable), 1 seed jar rim (radius of 9 centimeters), six jar rims (radi average of 9.6 centimeters), and two direct "chimney" rims for which no dete

mination of vessel form could be made (rim radius of 2.5 and 8 centimeters). This represents a minimum of five vessels.

In general, the ceramic sherds were notable for their homogeneity of type. Based on the typology and chronology developed by Waters (1981), the deposition of ceramics dates sometime between A.D. 700 and 1500, with an emphasis on the period following A.D. 950 based on the preponderance of Salton Buff sherds. Vessel forms represent several activities including storage and cooking. Use of pottery for cooking can also be inferred from evidence of burning on some sherds.

b. Ground Stone. Two items were identified (see Attachment 4). The first is a dark gray tabular granitic material, with one surface polished from use. The roughly triangular fragment measures 200 mm by 120 mm by 30 mm thick. It is classified as a metate fragment. The second item is a mano made from similar material, with one working surface and a pronounced shoulder. It measures 160 mm by 100 mm by 60 mm and weighs 1,359 g.

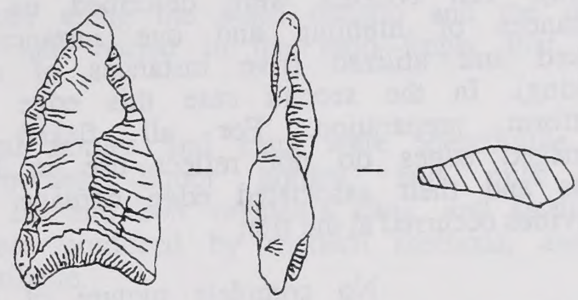
c. Lithics. Two points, four scrapers, and nine pieces of debitage were located (see Attachment 4). Several materials are represented: quartz, chalcedony, and fine-grained metavolcanics.

The two points are illustrated in Figure 9. One is constructed of black metavolcanic and shows some resemblance to the Rose Spring contracting stem type as defined in Heizer and Hester (1978) and Moratto (1984), although larger in size. Rose Spring points are dated to between A.D. 600-700 and A.D. 1100. Using Thomas' procedures for classification (1981), the point would be classified as a Gatecliff Contracting Stem. Thomas proposes a termination date for this series of approximately 1300 B.C. Point types of this variety are not well documented in the literature for the area. Its association with large quantities of Salton Buff provide an interesting potential for future chronological inquiry. This artifact is best described as a square-shouldered, square-stemmed projectile point. Its general size and morphology suggest that it was probably an atlatl dart point, rather than an arrow point.

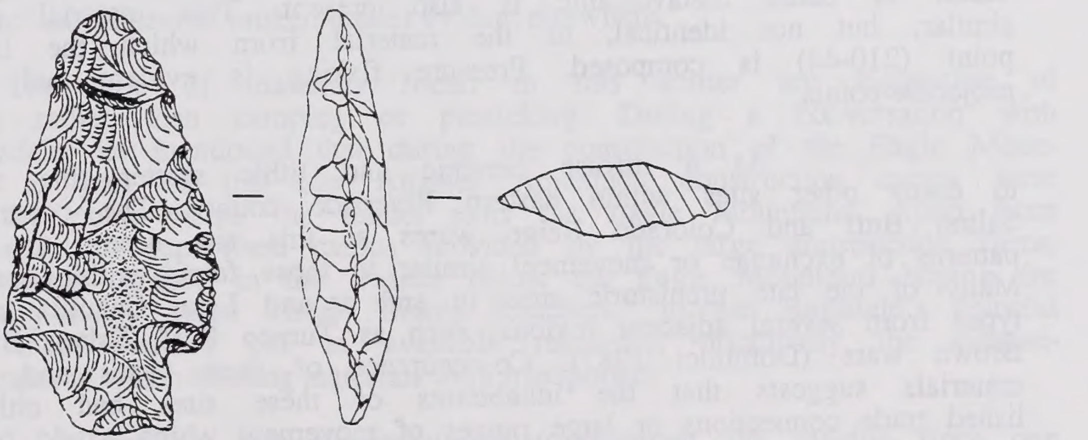
Dart points are not generally associated with late period sites in this region. It has been a general assumption of most prehistorians that the bow was well established in the desert southwest by the time ceramics were introduced (Warren and Crabtree 1986). Comparisons between artifact surface erosion within the assemblage provides some evidence that this projectile point is not associated with the remainder of the surface collections. Under magnification, the dart point shows significant smoothing of all exposed edges and flake scars. None of the other lithics from the assemblage show similar effects.

One possible explanation is that the artifact was curated from a much older site in the vicinity and transported to this location. Alternately, this site may actually represent two distinct components that have been deflated and mixed on the surface. No other evidence for this is provided by the artifacts, however.

The second point is an asymmetrical Cottonwood triangular point of quartz. Cottonwood points date to the Late cultural sequence as defined



210-34



210-44

SCALE TO ACTUAL SIZE

FIGURE 9. PROJECTILE POINTS FROM RIV-3798

above. Heizer and Hester (1978) date the Cottonwood series points to approximately A.D. 1300 to the historic period, within the period with which the Salton Buff ceramics are associated. This particular point is crude in execution, probably due to the poor nature of the material. It is best described as a Cottonwood series triangular base projectile point (Wilke 1974), probably used as an arrowhead.

The flaked lithic artifacts were analyzed based on an attribute system and provided with a traditional morphological label (see Attachment 4). Four scrapers are all made from small pieces of chalcedony, possibly core trimmings, which exhibit nibbling on at least one edge. Each of the four flaked lithic artifacts was analyzed according to attributes of its edges. Attributes were described for each "non-contiguous exclusive, damage event" or NEDE (Wade 1990). Ten NEDEs were described on the four scrapers: utilized only (three instances of nibbling and one instance of microstep flaking) and unifacially flaked and utilized (five instances of nibbling and one instance of microstep flaking). In the second case this edge damage may be partially the result of platform preparation. For all flaked lithic artifacts, the nature of the damaged edges do not reflect use in heavy processing. The limited range of tools and their associated edge damage implies that a limited set of economic activities occurred at the site.

No complete picture of the lithic reduction process on this site is discernible from the small amount of debitage recovered. Four different materials: quartz, quartzite, coarse, and fine-grained metavolcanics are represented among the nine flakes and pieces of shatter. Two of the quartz flakes appear to be bifacial thinning flakes, and were produced from a better quality material than the projectile point. One large bifacial thinning flake of a basalt or black metavolcanic is also present. This material appears to be similar, but not identical, to the material from which the larger projectile point (210-44) is composed. Pressure flaking is evident only on the two projectile points.

As a diffuse ceramic and lithic scatter this site is similar to many other sites within eastern Riverside county. The occurrence of both Salton Buff and Colorado Beige wares at this site seems to reflect general patterns of exchange or movement similar to those found within the Salton Basin. Many of the late prehistoric sites in and around Lake Cahuilla contain ceramic types from several adjacent regions, such as Tumco Buff, Salton Buff, and Tizon Brown ware (Dominici 1987). Co-occurance of these types and various exotic materials suggests that the inhabitants of these sites had either well-established trade connections or large ranges of movement which would bring them into contact with the sources of non-local items.

2. <u>Prehistoric Isolates</u>

a. <u>Section 27 Sherd (EMRR-A)</u>. Not classifiable as one of the recognized Desert wares, the fragment is roughly triangular, approximately 50 mm on a side, and weighs 14.5 grams. It shows no evidence of being exposed to fire and bears no decoration or markings. A mixture of both mountain and sedimentary clays was used in the manufacturing process.

b. <u>Section 21 Debitage (EMRR-C, EMRR-D, EMRR-E)</u>. The three isolates found on this parcel were all struck from different chalcedony (jasper)

cores. All were interior (no cortex) flakes less than 30 mm in length. No inferences were drawn from these isolates.

c. Other Debitage (EMRR-B, EMRR-F, EMRR-G, EMRR-H, EMRR-I). No inferences were drawn from these single flakes. B, F, and G were fashioned of chalcedony; H was obsidian; and I was quartz. No cortex was observed on any of the isolated flakes. The largest of the lot was less than 40 mm overall. No distinguishing attributes were noted by the field team.

3. Section 27 Trash Scatter

The scatter includes approximately 50 cans, some 20 bottles, and other household articles: an enameled cook pot, a kitchen spoon, and a rubber-stamp pad. The diffusion of the scatter along the wash margin and the observation that some of the artifacts were half buried in the sand imply that this is a secondary deposition.

Within the scatter, several bottles and cans were identifiable as to function: mason jars, condiment bottles, liquor bottles, and milk bottles together with evaporated milk, No. 2 1/2 and 303 vegetable cans, and sardine and Spam cans. All cans and bottles were produced by modern methods, and their equivalents are currently commercially available.

Some products were identifiable by brand. Bottles which formerly contained Four Roses Blended Whiskey, Best Foods, and CHB honey; a medicinal product named Knoxall; and a lotion manufactured and/or distributed by A. S. Hinds were found intact. That some of the larger bottles (for example, the one-quart milk and the whiskey) were unbroken stands in sharp contrast to the normal "target practice" assortment of broken bottles evident elsewhere.

The type of materials found in this scatter are suggestive of housekeeping rather than camping or picnicking. During a conversation with Stanley Ragsdale, he mentioned that during the construction of the Eagle Mountain tunnel, as part of the Los Angeles Aqueduct, construction camps were situated at the point where the tunnel exits the Eagle Mountains. Apart from these organized and supervised camps provided by the large construction firms, individual workers camped in the washes below the Eagle Mountains hoping for jobs on a day-to-day basis. These "Stump Ranchers," to use Ragsdale's colorful term, built their shanties out of available resources, principally the substantial wooden crates in which blasting materials were transported.

It is possible that the scatter may represent the residue from one of these habitations, no artifacts capable of providing the requisite terminus ante quem were identified. The deposit cannot be positively dated earlier than 1940, and could easily be as recent as 1960 or even later. Its composition, size, and location suggest strongly that it is not an in situ deposit. Given that the integrity of the deposit is likely compromised by redeposition, that the range of artifacts is narrow, and that no evidence was discovered to date the project within the period of interest, this deposit is not considered to represent a historic resource, and recordation is not appropriate.

4. Section 27 Bottle Fragments

Even though "sun purpling" of glass is indicative of manufacture prior to World War I, the lack of association between the three bottle fragments and any other cultural material makes them useless for cultural analysis.

V. RECOMMENDATIONS

A. Riv-3798

As a result of the documentation it has been demonstrated that no subsurface site remains exist along the railroad cut. It has also been shown that the site is seriously damaged by the excavation of the railroad cut, an old road, the placement of a backdirt pile, and erosion. Additional surface artifacts are located southeast of the backdirt pile, and are also disturbed by erosion.

Actions related to the railroad which will result from implementation of the proposed project consist of transportation of trash along the rail line, rehabilitation of the railroad, and probable replacement of unstable tressels. No tressels exist within the site area. Rehabilitation of the railroad and required maintenance activities will include track straightening and alignment, ballast regulation, culvery cleanout and repair, vegetation control, and oiler maintenance. The proposed railroad rehabilitation activities will not involve excavations or movement of dirt.

No remains of site Riv-3798 are in proximity to the railroad, as the construction of the railroad created an 11-meter cut removing the center of the site. The cut faces documented during the field investigations revealed that no subsurface remains of the site exist in the remaining site area adjacent to the railroad. Therefore, because no project elements would disturb areas outside of the railroad cut, the project would have no effect on the remaining portion of site Riv-3798. No further action is recommended.

B. ISOLATES

1. National Register Assessment

The prehistoric isolates located by the survey fall into the named categories of archaeological sites generally ineligible as defined by the California Desert District of the BLM's Contractor Directives.

2. Recommendation

Recordation of these isolated artifacts has exhausted their potential to aid archaeological research, and no further action is recommended.

C. HISTORIC CULTURAL RESOURCES

No structures, sites, buildings or objects which qualify as historic cultural resources were located during the survey. Thus, assessment for the National Register is not applicable.

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VII. PROJECT STAFF

Charles S. Bull	Supervisory Archaeologist
Sue A. Wade	Senior Archaeologist
McMillan Davis	Project Archaeologist
Frank Ritz	Field Archaeologist and Historical Researcher
John L. Whitehouse	Field Archaeologist and Crew Leader (South)
Cheryl Bowden	Field Archaeologist and Laboratory Analyst
Russell Collett	Field Archaeologist
Karen Knight	Field Archaeologist
Carleen Leeper	Field Archaeologist
Carol Schultze	Field Archaeologist
Larry Tift	Field Archaeologist
Loretta Gross	Production Supervisor
Harry Price	Senior Technical Illustrator
Stacey Tomlinson	Production Specialist

ATTACHMENTS

ATTACHMENT 1

Attachment 1

On file at the County of Riverside, Bureau of Land Management (Palm Springs), and RECON.

ATTACHMENT 2

Attachment 2

On file at the County of Riverside, Bureau of Land Management (Palm Springs), and RECON.

ATTACHMENT 3

Cultural Systems Research, Inc.

823 Valparaiso Avenue, Menlo Park, California 94025

(415) 323-9261 • (415) 832-8489

February 27, 1990

Dr. Charles Bull
President, RECON
1276 Morena Blvd.
San Diego, CA 92110-3815

Re: Native American Consultation for Eagle Mountain (RECON Number 2100A)

Dear Dr. Bull:

We are sending you herewith a report on the study we have conducted for you to determine whether, and to what extent, the proposed use of Eagle Mountain Mine, northeast of Desert Center, for non-hazardous landfill will impact cultural resources of concern to Native Americans whose traditional territory lay in this area. Please let us know if there is any further information you need.

We shall be mailing a hard copy of the report as well as a disc copy, WordPerfect 4.2.

This has been an interesting project. We hope we'll be working with RECON again.

Sincerely,
CULTURAL SYSTEMS RESEARCH, INC.

Sylvia Vane

Sylvia Brakke Vane
Vice President

cc.
Mr. Dennis Miller, Chairman, Morongo Tribal Council
Mr. Richard Milanovich, Chairman, Agua Caliente Tribal Council
Mr. John James, Chairman, Twentynine Palms General Council
Mr. Daniel Eddie, Jr., Chairman, Colorado River Tribal Council
Ms. Nora Garcia, Chairperson, Fort Mohave Tribal Council
Mr. Robert Pride, Chairperson, Torres-Martinez Council
Ms. Christine Walker, Chairman, Chemehuevi Tribal Council
Ms. June Mike, Chairman, Twenty-Nine Palms General Council
Mr.Russell Kaldenberg, Bureau of Land Management, Palm Springs

ATTACHMENT NO. 3. Current Ethnology and Native American Concerns, by Cultural Systems Research, Inc.

NATIVE AMERICAN CONCERNS

Cultural Systems Research, Inc. (CSRI) has conducted a study for Regional Environmental Consultants (RECON) to determine whether, and to what extent, the proposed use of the Eagle Mountain Mine, northeast of Desert Center, for non-hazardous landfill will impact cultural resources of concern to Native Americans whose traditional territory lay in this area. This is a report on CSRI's findings.

METHOD

This study began with a consultation on January 10, 1990 between RECON Project Archaeologist McMillan Davis and Lowell John Bean, Ph.D., and Sylvia Brakke Vane, M.A., of CSRI. The project was described by Davis and other RECON staff members, and it was agreed that CSRI would complete a draft report by March 1, 1990.

CSRI's work on the project was conducted by Bean, Vane, and Ethnographer Jackson Young. Bean and Vane planned the research, and decided, on the basis of information gained in previous research, that the vicinity in which the Eagle Mountain mine is located would have been with the traditional territory of the Mojave, Chemehuevi, and Cahuilla Indians, and that therefore the following reservations should be given an opportunity to comment on the proposal to use the mine for landfill, as proposed by the Mine Reclamation Corporation: Fort Mojave Indian Reservation (Mojaves), Chemehuevi Indian Reservation (Chemehuevi), Colorado River Indian Reservation (Mojave and Chemehuevi), Twentynine Palms Indian Reservation (Chemehuevi), Morongo Indian Reservation (Cahuilla, Serrano, and Chemehuevi), Agua Caliente Indian Reservation (Cahuilla), Cabazon Indian Reservation (Cahuilla and Chemehuevi), and Torres-Martinez Indian Reservation (Cahuilla). Letters describing the project, and saying that we would be touch with them to make arrangements to visit the mine area were sent the chairpersons of the governing bodies of each of these reservations on January 17.

Commencing on January 24, Young made phone calls to each reservation. Vane and Young also discussed the project with several Mojave and Cahuilla elders with whom they have recently been working. It was eventually decided that a trip to the vicinity of the mine would be made on Monday, February 19.

It had been determined by February 19 that Morongo Indian Reservation, Agua Caliente Indian Reservation, and Cabazon Indian Reservation did not wish to visit the mine area, nor to make any statement with respect to the project. Fort Mojave Indian Reservation, and Chemehuevi Indian Reservation had expressed interest, but in the event did not join in the visit to the mine nor make a statement.

The participants in the visit to the mine area were Vane and Young from CSRI, a Chemehuevi and two Mojaves from the Colorado River Indian Tribes (CRIT), and a Cahuilla elder from Torres-Martinez Indian Reservation.

In the meantime, a search of the literature had been made by Vane to find evidence of use of the area by Native American groups, and a trip to Joshua Tree

National Monument headquarters was made by Bean and Vane on January 26. The purpose of this trip was to determine whether the collection of artifacts held at the monument included any found in the vicinity of the mine, and to examine any found and their provenience.

This report has been written by Vane and edited by Bean.

RESULTS OF RESEARCH

Territorial Boundaries. One purpose of the research was to determine whether the assumption that modern-day Mojave, Chemehuevi, and Cahuilla represent the descendants of most of the tribal groups that would traditionally have used the vicinity of the Eagle Mountain Mine is a reasonable assumption. Our study showed that the Eagle Mountains were probably used by the Cahuilla in the "ethnographic present," and by the Chemehuevi from the mid-nineteenth century on. They may have been used by the "Desert Mojave," at an earlier time. For as long as the present climatic conditions have existed, these mountains have probably been mainly a place to hunt mountain sheep and deer, an area of temporary, but not permanent, campsites. The Native Americans to whom we talked, using their interlocking fingers to demonstrate, spoke of this being an area where the territories of several groups might overlap, with now one group and then another coming in to hunt. The Chemehuevi spoke of its being primarily "Desert Mojave" territory, whereas the Mojaves assigned it to the Chemehuevi.

The Cahuilla consultant had himself come to hunt for mountain sheep and deer in the Eagle Mountains "fifty years ago" with John Hilton and another non-Indian. He remembers a large cottonwood tree and a stream that flowed mostly underground, coming to the surface only at intervals. He says the mine has changed the landscape so much that he cannot say exactly where this cottonwood tree and the stream would have been.

This consultant remembers an older tradition. There were about fifty wild burros in Borrego Valley. Led by Lupe Lugo, a number of young Cahuillas mounted on horseback chased the burros to Torro, thence to Tuva (now under the Salton Sea), on to Desert Center, and finally up into the Eagle Mountains. He also points out that in traditional times Cahuillas would come from what are now the Cahuilla and Santa Rosa reservations to Torro and then go on to Yuma--hence they must have known the trails and where the springs were.

Lupe Lugo, our consultant said, also drove cattle from the Coachella Valley to Blythe, and would have come through the Eagle Mountains with them.

Bean (1978:75) describes Cahuilla territory as extending as far south as the Chocolate Mountains and as far east as "a part of the Colorado Desert west of Orocopia mountain." Personnel at the Joshua Tree National Monument have been considering the Eagle Mountains as Cahuilla territory, though their collection does not contain artifacts that can be assigned a specific ethnic group. No Cahuilla oral literature pertaining to the Eagle Mountains is known to us.

Mojave traditional territory lies primarily along the Colorado River, where they are known to have lived ever since the Spanish explorer Oñate described finding "Amacavas" in 1604, but present-day Mojave say that the Mojave territory also included the whole of the Mohave Desert, and that they are concerned about anything

that impacts that desert. Mojave oral literature (Kroeber 1948, 1951, and 1972), which consists primarily of songs that describe a journey, speaks mainly of the vicinity of the Colorado River, but some songs take the listener into what is now Arizona, as well as into the Mohave Desert in California. The Tehachapi Mountains and places along the Mohave River are mentioned fairly frequently. The only published reference that could possibly include the Eagle Mountain area was "A Mohave Historical Epic" (Kroeber 1951), in which two leaders from the Mohave Valley migrate to the Providence Mountains, thence to a mountain east of San Bernardino which may have been San Gorgonio Peak, and then, after a two day stay, went on to the "Kamia country" on the Colorado River via a place where *Haoikwa* and Quail lived. This place is unidentified, but it is said they lived on two different kinds of grass seeds while there (Kroeber 1951:77). This story, regardless of where this stopping place was, suggests an occasional foray into the Colorado Desert, and possibly the Eagle Mountain area, by the Mojaves.

Although our Chemehuevi consultant said that Chemehuevis and other Southern Paiutes came from as far away as Pahrump to hunt in or travel across the Eagle Mountian area, the main Chemehuevi use of the Eagle Mountain area would have been after several Chemehuevi families moved into the Coachella Valley reservations (into which they married), and especially the Twentynine Palms Reservation, set aside as a reservation after the Mojave-Chemehuevi war in the 1860s. The Eagle Mountains would have been a convenient hunting area for people living in the Twentynine Palms area.

Chemehuevi songs, as mapped by Laird (1976), pertained to an area closer to the Colorado River and not extending into this vicinity.

The Chemehuevi consultant noted a recent association of Chemehuevi with the Eagle Mountain Mine in that a nephew of hers, while living with a foster family, attended the Eagle Mountain High School.

Our consultants fell to talking of the real, as opposed to the fictional, Willie Boy. He was Chemehuevi, from the Wicke family, son of Mary Snyder of Morongo. He escaped via Whitewater and Twentynine Palms to the Parker area and was not killed by the posse that went after him. He took refuge in a cave north of Twentynine Palms and was brought food by a cousin. He had been a good hunter and knew the water holes in these mountains. After his death, his mother walked from Morongo to Parker--she also knew where to find food and water.

Impact of Project. None of the Native American consultants identified the Eagle Mountains as sacred or having special significance to their people. One of the Mojaves, emphasizing that he was speaking out of concern for all citizens and not just Indians, noted that wastes identified as non-hazardous had a way of turning out to be hazardous, and opposed using the site for landfill. All the CRIT consultants were concerned about the possibility of inadvertent dumping of materials that might turn out to be hazardous, their reservation having had such an experience itself. CRIT had contracted to let a firm dump several hundred truckloads of ground-up materials from automobile interiors on the reservation. The materials were allowed to aerate on the surface for a time, and were then covered with dirt. Unfortunately, chemical reactions occurring after several months brought about an explosion, and the landfill operation had to brought to an end. The materials had contained many PCBs.

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ATTACHMENT 4

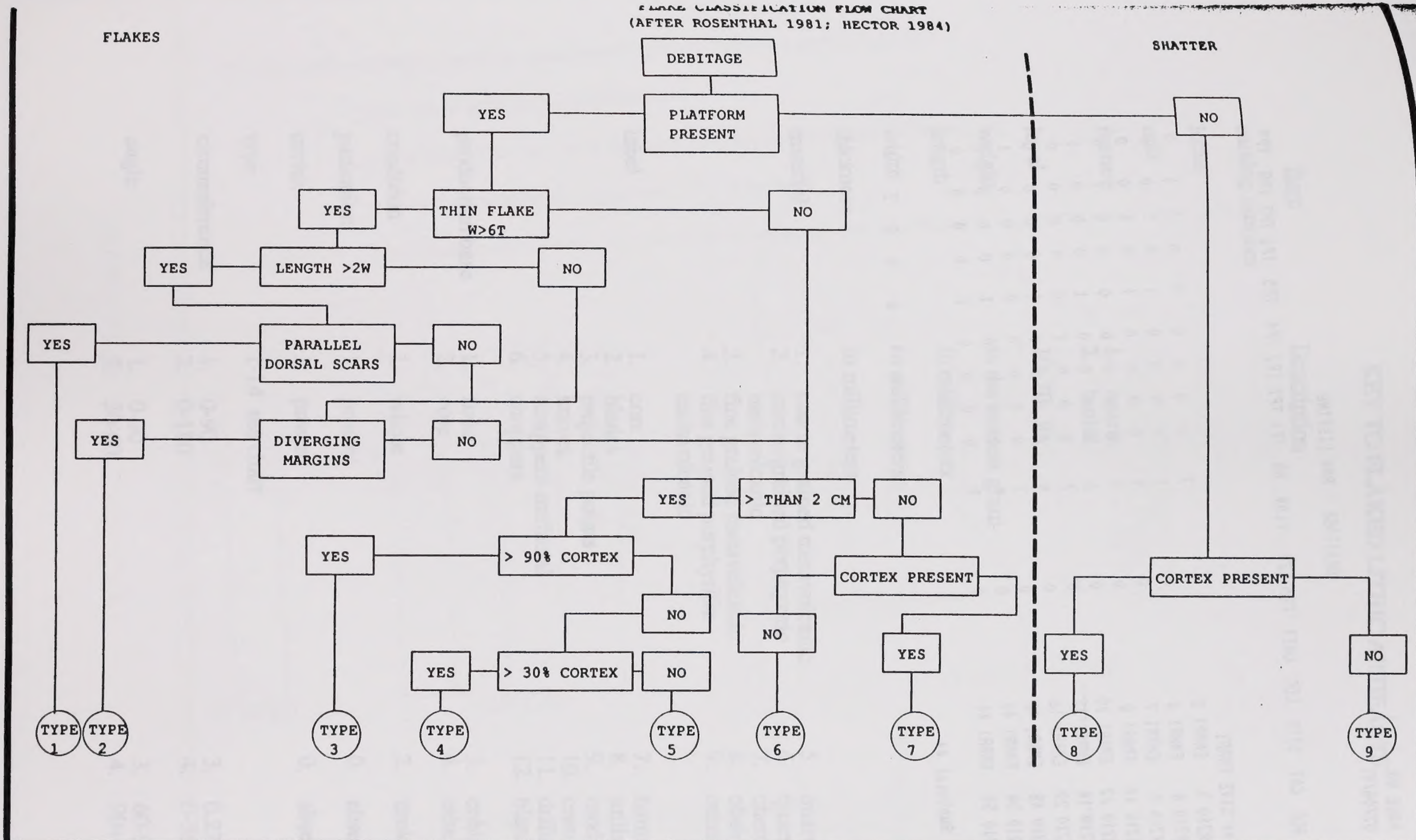
KEY TO FLAKES AND SHATTER

Item	Description
accession number	RECON: R000 WESTEC: W000
catalog number	
site number	00000 for SDi-#s W0000 for SDM-W-#s
locus	
unit	
category	2. debitage
feature	1. hearth 2. burial
level	10, 20, 30, . . .
material	1. coarse grained metavolcanic 2. coarse grained porphyritic metavolcanic 3. fine grained metavolcanic 4. fine grained porphyritic metavolcanic 5. quartzite 6. quartz 7. chert/chalcedony 8. obsidian 9. other
flake types	counts of each type within the material type specified; see attached flow diagram

FLAKE TYPOLOGY

Type	Bulb	Platform	Relative Length	Cortex	Dorsal Scars	Other	Assumed Process
1	Present	Present	2x w	--	2+	Parallel sides	Specialized blade type
2	Present	Present	--	--	--	Diverging, thin	Bifacial thinning
3	Present	Present	2+ cm	80%	0	--	Platform creation, cortex removal
4	Present	Present	2+ cm	30-80%	0-1	--	Cortex removal
5	Present	Present	2+ cm	-30%	1+	--	Core reduction, basic shaping
6	Present	Present	-2 cm	0%	1+	--	Finishing, resharpening
7	Present	Present	-2 cm	Present	1+	--	Trimming
8	Absent	Absent	--	Present	--	--	Shatter during primary reduction
9	Absent	Absent	--	Absent	--	--	Shatter during secondary reduction

Source: After Norwood, Bull, and Rosenthal 1981.



FLAKE CLASSIFICATION FLOW CHART (AFTER ROSENTHAL, 1981 AND HECTOR, 1984)

PAGE NO. 1
02/06/91

DEBITAGE - RAW LISTING

ACC	CAT	SITE	LOC	UNIT	FEA	LEV	FLD#	MA	TP1	TP2	TP3	TP4	TP5	TP6	TP7	TP8	TP9
** SITE EMRR1																	
R210	3	EMRR1	2			0		7	0	0	0	0	0	0	0	1	0
R210	8	EMRR1	6			0		1	0	0	0	0	1	0	0	0	0
R210	9	EMRR1	7			0		9	0	0	0	0	1	0	0	0	0
R210	10	EMRR1	8			0		7	0	0	0	0	0	0	0	1	0
R210	12	EMRR1	10			0		6	0	0	0	0	1	0	0	0	0
R210	16	EMRR1	12			0		7	0	0	0	1	0	0	0	0	0
R210	22	EMRR1	16			0		5	0	0	0	0	1	0	0	0	0
R210	48	EMRR1	40			0		7	0	0	0	0	0	0	0	0	1
R210	54	EMRR1	46			0		7	0	0	0	0	1	0	0	0	0
R210	54	EMRR1	46			0		7	0	0	0	0	1	0	0	0	0
** Subtotal **									0	0	0	1	6	0	0	2	1

KEY TO FLAKED LITHIC ARTIFACTS

Item	Description			
catalog number				
locus				
unit				
feature	1.	hearth		
	2.	burial		
level	10, 20, 30, . . .			
weight	to the nearest gram			
length	in millimeters			
width	in millimeters			
thickness	in millimeters			
material	1.	coarse grained metavolcanic	5.	quartzite
	2.	coarse grained porphyritic metavolcanic	6.	quartz
			7.	chert/chalcedony
	3.	fine grained metavolcanic	8.	obsidian
	4.	fine grained porphyritic metavolcanic	9.	other
label	1.	core	7.	hammers
	2.	blades	8.	utilized flakes
	3.	projectile points	9.	modified flakes
	4.	knives	10.	crescentii
	5.	scrappers-unifacial	11.	drills
	6.	choppers	12.	blanks
production base	1.	flake	3.	cobble
	2.	core	4.	other
condition	1.	whole	2.	broken
patination	1.	present	0.	absent
cortex	1.	present	0.	absent
type	1-14 see chart			
circumference	1.	0-90	3.	0.270
	2.	0-180	4.	0-360
angle	1.	0-30	3.	60-90
	2.	30-60	4.	90+

IDENTIFICATION OF NON-CONTIGUOUS, EXCLUSIVE DAMAGE EVENTS (NEDEs)

FLAKED		UTILIZED					FLAKED & UTILIZED									
							UNIFACIAL					BIFACIAL				
unifacial	bifacial	rounding	nibbling	microstepping	crushing	battering	rounding	nibbling	microstepping	crushing	battering	rounding	nibbling	microstepping	crushing	battering
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17

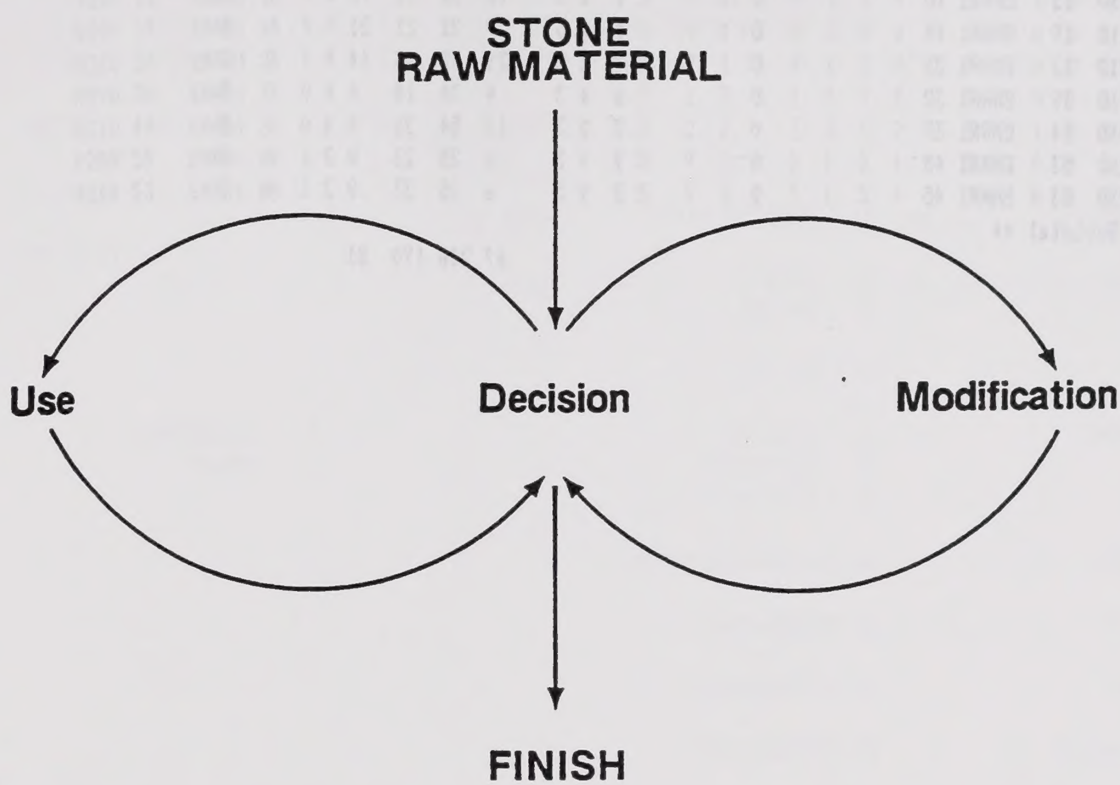
NOTE: NEDEs-- are continuous along a line not broken by an angle less than 90 degrees or undamaged area (noncontiguous)

are continuous breakage of the same type (exclusive)

can be interrupted by recent breakage and still be interpreted as continuous

does not include platform preparation

Circumference--A circle defined by diameter equaling the maximum length of artifact



NEDES TASK EVENT PROCESS

02/06/91

RAW LISTING FOR FLAKED LITHIC ARTIFACTS - DESCRIPTIVE

ACC	CAT	SITE	LOCUS	UNIT	FEA	LEV	FNO	M	C	LB	WT	LN	WD	TH	P	PD	CR	NN
** SITE EMRR1																		
R210	13	EMRR1	10			0		7	1	5	10	24	36	16	2	0	1	4
R210	19	EMRR1	14			0		7	1	5	9	22	21	21	4	0	1	1
R210	32	EMRR1	26			0		7	1	5	21	32	43	14	4	1	0	2
R210	39	EMRR1	32			0		6	1	3	4	34	18	6	4	0	0	3
R210	44	EMRR1	37			0		3	1	3	11	54	26	8	4	0	0	5
R210	53	EMRR1	45			0		7	1	5	6	25	23	8	2	1	0	3
R210	53	EMRR1	45			0		7	1	5	6	25	23	8	2	1	0	3
** Subtotal **																		
											67	216	190	81				

02/06/91

RAW LISTING FOR FLAKED LITHIC ARTIFACTS - ATRIBUTES

ACC	CAT	SITE	LOCUS	UNIT	FEA	LEV	FND	M	C	LB	T1	C1	A1	T2	C2	A2	T3	C3	A3	T4	C4	A4	NN
** SITE EMRR1																							
R210	13	EMRR1	10			0		7	1	5	4	1	3	9	1	3	9	1	3	9	1	3	4
R210	19	EMRR1	14			0		7	1	5	10	1	3	0	0	0	0	0	0	0	0	0	1
R210	32	EMRR1	26			0		7	1	5	9	1	3	4	1	3	0	0	0	0	0	0	2
R210	39	EMRR1	32			0		5	1	3	1	2	3	1	2	3	2	1	3	0	0	0	3
R210	44	EMRR1	37			0		3	1	3	2	2	1	2	2	1	2	1	2	2	1	2	5
R210	53	EMRR1	45			0		7	1	5	9	2	2	5	1	3	4	1	3	0	0	0	3
R210	53	EMRR1	45			0		7	1	5	9	2	2	5	1	3	4	1	3	0	0	0	3

KEY TO GROUND STONE

Item	Description	
accession number	RECON: R000 WESTEC: W000	
catalog number		
site number	00000 for SDi-#s W0000 for SDM-W-#s	
locus		
unit		
category	5. ground stone	
feature	1. hearth 2. burial	
level	10, 20, 30, . . .	
material	1. granite 2. quartzite 3. andesite	4. sandstone 5. other
weight	to the nearest gram	
length	in millimeters	
width	in millimeters	
thickness	in millimeters	
condition	1. whole	2. broken
type	1. mano 2. pestle 3. slab	4. basin 5. bowl 6. other
shaped	1. unshaped	2. broken

(shaped manos/pestles are shouldered, bifacial, and have edge treatment to produce a tabular profile)

number of faces	1 face 2 faces	3 faces 4 faces
battering	1. end 2. side	3. both

side 1 (ground surface of metate):
length/width/depth in millimeters

side 2 (ground surface of metate):
length/width/depth in millimeters

RAW LISTING FOR GROUNDSTONE

ACC	CAT	SITE	LOC	UNIT	LEV	FDN	MT	WGT	LN	WD	TH	C	T	SH	F	B	L1	W1	D1	L2	W2	D2
** SITE EMRR1																						
R210	49	EMRR1	41		0		1	1359	158	101	60	1	1	1	1	0	0	0	0	0	0	0
R210	56	EMRR1	48		0		5	1287	214	141	33	2	3	1	1	0	170	97	5	0	0	0
R210	49	EMRR1	41		0		1	1359	158	101	60	1	1	1	1	0	0	0	0	0	0	0
R210	56	EMRR1	48		0		5	1287	214	141	33	2	3	1	1	0	170	95	5	0	0	0
** Subtotal **																						
								5292									340	192	10	0	0	0
*** Total ***																						
								5292									340	192	10	0	0	0

KEY TO POTTERY ATTRIBUTES DATA LISTING

ACC: ACCESSION #

CAT#: CATALOG NUMBER

SITE#: SITE NUMBER

WGHT: WEIGHT
to the nearest tenth gram

TYP: POTTERY TYPE
SB = Salton Buff
CB = Colorado Beige

RM: RIM
Y = Yes
N = No

MUNS-INT: MUNSELL COLOR-INTERIOR

MUNS-EXT: MUNSELL COLOR-EXTERIOR

TH: THICKNESS

Riv-3798 pottery

ACC	CAT#	SITE#	TYP	WGHT	RM	MUNS-INT	MUNS-EXT	TH
R210	1	R3798	SB	2.8	Y	5 YR8/2	5 Y7/3	4
R210	2	R3798	SB	8.7	Y	7.5YR7/4	7.5YR5/4	5
R210	14	R3798	SB	21.5	N	10 YR7/2	10 YR7/1	5
R210	15	R3798	SB	12.8	Y	7.5YR6/4	7.5YR7/4	7
R210	17	R3798	CB	17.5	N	2.5 Y6/2	2.5 Y5/2	4
R210	20	R3798	SB	11.6	N	10 YR5/1	10 YR6/2	3
R210	23	R3798	SB	8.0	N	5 YR4/1	10 YR7/3	4
R210	33	R3798	SB	7.7	N	7.5YR6/4	7.5YR8/2	3
R210	45	R3798	SB	9.4	Y	10 YR6/3	10 YR6/1	6
R210	46	R3798	SB	5.1	N	7.5YRN4/	10 YR7/1	5
R210	47	R3798	CB	10.5	Y	10 YR7/3	10 YR7/2	4
R210	4A	R3798	SB	17.7	N	7.5YR8/2	5 YR6/6	4
R210	4B	R3798	CB	43.5	N	10 YR6/2	2.5YRN5/	7
R210	50	R3798	SB	3.5	N	10 YR7/2	7.5YRN4/	3
R210	51	R3798	SB	2.9	N	7.5YR6/4	10 YR7/3	5
R210	52	R3798	SB	9.2	N	7.5YR6/2	10 YR7/1	5
R210	55	R3798	SB	9.1	N	2.5YR6/6	2.5YRN6/	3
R210	5A	R3798	CB	11.8	Y	7.5YR7/2	7.5YR8/2	6
R210	5B	R3798	CB	10.0	Y	7.5YR8/2	7.5YR7/4	7
R210	6A	R3798	SB	12.4	Y	10 YR7/2	2.5 Y7/2	5
R210	6B	R3798	CB	49.5	N	7.5YR6/4	7.5YR7/2	7
R210	6C	R3798	SB	10.7	N	10 YR7/1	10 YR7/3	3
R210	6D	R3798	SB	4.2	N	7.5YR7/2	10 YR5/1	5
R210	7A	R3798	SB	6.4	N	10 YR7/2	10 YR5/2	4
R210	7B	R3798	SB	5.5	N	10 YR6/2	10 YR7/1	4
R210	7C	R3798	SB	3.1	N	10 YR7/2	2.5 Y6/2	4
R210	7D	R3798	SB	2.6	N	10 YR7/3	10 YR6/1	4
R210	11A	R3798	SB	1.0	N	10 YR6/2	2.5 Y7/2	2
R210	11B	R3798	SB	1.5	N	2.5 Y7/2	2.5 Y7/2	2
R210	11C	R3798	SB	14.8	N	5 YR6/2	5 YR7/4	6
R210	11D	R3798	SB	8.8	N	7.5YR7/2	7.5YR5/2	5
R210	11E	R3798	SB	6.5	N	5 YR6/3	5 YR5/3	4
R210	18A	R3798	CB	18.0	Y	7.5YR7/2	5 YR6/6	7
R210	18B	R3798	SB	3.1	N	5 YR6/1	5 YR6/6	4
R210	18C	R3798	SB	2.7	N	7.5YRN5/	5 YR6/3	4
R210	18D	R3798	SB	1.6	N	7.5YR6/2	7.5YR6/2	3
R210	18E	R3798	SB	4.3	N	7.5YR7/4	10 YR7/2	4
R210	21A	R3798	SB	10.2	Y	10 YR7/3	10 YR6/2	5
R210	21B	R3798	SB	18.3	N	10 YR6/2	10 YR6/2	4
R210	21C	R3798	SB	19.3	N	10 YR5/1	7.5YR7/4	3
R210	21D	R3798	SB	8.4	N	10 YR7/3	10 YR5/1	4
R210	21E	R3798	SB	19.5	N	2.5 Y8/2	10 YR7/3	8
R210	21F	R3798	SB	5.1	N	10 YR6/2	10 YR5/1	4
R210	21G	R3798	SB	2.0	N	7.5YR7/4	10 YR7/3	3
R210	24A	R3798	SB	16.3	Y	2.5 Y6/2	2.5 Y7/2	6
R210	24B	R3798	SB	15.9	N	10 YR7/2	10 YR5/1	5
R210	24C	R3798	SB	2.8	N	10 YR6/2	10 YR6/2	3
R210	24D	R3798	SB	5.7	N	10 YR7/2	10 YR5/2	5
R210	24E	R3798	SB	8.0	N	2.5 Y6/2	2.5 Y5/2	5
R210	24F	R3798	SB	3.7	N	2.5 Y7/2	2.5 Y5/2	4
R210	24G	R3798	SB	3.8	N	2.5 Y6/2	2.5 Y5/2	3

Riv-3798 pottery

ACC	CAT#	SITE#	TYP	WGHT	RM	MUNS-INT	MUNS-EXT	TH
R210	24H	R3798	SB	5.8	N	7.5YR7/4	10 YR7/4	5
R210	24I	R3798	SB	2.2	N	10 YR7/3	2.5 Y7/2	4
R210	25A	R3798	SB	7.3	Y	2.5 YN3/	2.5 YN4/	4
R210	25B	R3798	SB	1.9	N	10 YR6/3	5 YR6/4	2
R210	26A	R3798	SB	2.6	N	5 YR7/4	5 YR5/1	3
R210	26B	R3798	SB	3.5	N	10 YR7/2	5 YR4/3	3
R210	26C	R3798	SB	3.6	Y	10 YR7/1	5 YR4/2	3
R210	26D	R3798	SB	3.8	N	7.5YR6/2	10 YR6/2	4
R210	26E	R3798	SB	3.8	N	5 YR7/4	7.5YR6/2	2
R210	27A	R3798	SB	26.3	N	7.5YRN4/	7.5YRN5/	5
R210	27B	R3798	SB	10.6	N	10 YR6/2	10 YR5/1	4
R210	27C	R3798	SB	9.1	N	10 YR7/2	10 YR6/2	3
R210	27D	R3798	SB	19.0	N	7.5YR6/2	7.5YR6/2	4
R210	28A	R3798	SB	7.1	Y	5 YR7/4	5 YR7/4	5
R210	28B	R3798	SB	2.7	N	10 YR6/2	10 YR7/2	3
R210	29A	R3798	SB	3.8	N	10 YR6/2	2.5 Y6/2	3
R210	29B	R3798	SB	6.7	N	2.5 Y6/2	2.5 Y5/2	3
R210	29C	R3798	SB	4.1	N	2.5 Y6/2	2.5 Y5/2	3
R210	29D	R3798	SB	1.6	N	2.5 Y6/2	10 YR5/2	3
R210	29E	R3798	SB	2.0	N	2.5 Y6/2	10 YR5/2	3
R210	29F	R3798	SB	3.6	N	10 YR6/2	10 YR5/1	5
R210	29G	R3798	SB	1.9	N	10 YR6/2	10 YR6/2	3
R210	29H	R3798	SB	1.7	N	2.5 Y6/2	10 YR6/3	3
R210	29I	R3798	SB	2.0	N	2.5 Y6/2	2.5 Y5/2	3
R210	29J	R3798	SB	3.9	N	10 YR6/2	10 YR5/1	4
R210	30A	R3798	SB	9.6	Y	10 YR7/2	10 YR5/1	7
R210	30B	R3798	SB	5.1	N	10 YR7/1	10 YR5/1	5
R210	31A	R3798	SB	3.3	N	7.5YR6/2	7.5YRN5/	4
R210	31B	R3798	SB	3.4	N	7.5YRN5/	10 YR7/2	3
R210	31C	R3798	SB	1.6	N	5 YR5/4	10 YR6/2	4
R210	34A	R3798	SB	9.1	Y	10 YR7/2	10 YR7/2	5
R210	34B	R3798	SB	7.0	N	10 YR7/3	10 YR5/1	4
R210	35A	R3798	SB	3.7	Y	10 YR7/3	10 YR7/3	4
R210	35B	R3798	SB	18.3	N	10 YR5/1	10 YR6/2	4
R210	36A	R3798	SB	6.1	N	2.5 YN5/	10 YR6/1	2
R210	36B	R3798	SB	6.1	N	10 YR7/2	2.5 YN5/	4
R210	37A	R3798	SB	27.2	Y	10 YR7/1	7.5YR7/4	6
R210	37B	R3798	CB	10.7	N	10 YR6/1	10 YR6/3	5
R210	37C	R3798	SB	21.9	N	10 YR5/1	10 YR8/3	9
R210	37D	R3798	SB	7.9	N	10 YR7/2	10 YR5/1	3
R210	38A	R3798	SB	19.6	N	10 YR6/3	10 YR7/3	5
R210	38B	R3798	SB	2.2	N	7.5YR7/4	7.5YR6/4	5
R210	38C	R3798	SB	6.1	N	10 YR5/2	10 YR5/1	5
R210	40A	R3798	SB	9.7	Y	10 YR6/1	7.5YR6/4	7
R210	40B	R3798	SB	10.1	N	7.5YRN4/	10 YR7/1	6
R210	41A	R3798	SB	13.7	N	7.5YR6/4	10 YR8/3	3
R210	41B	R3798	SB	14.5	N	2.5YR6/4	7.5YR7/2	4
R210	41C	R3798	SB	8.4	N	7.5YR7/2	10 YR7/1	4
R210	42A	R3798	SB	24.3	N	10 YR6/1	10 YR5/1	3
R210	42B	R3798	SB	2.2	N	10 YR6/1	10 YR5/1	3
R210	42C	R3798	SB	5.7	N	10 YR6/1	10 YR5/1	3

Riv-3798 pottery

ACC	CAT#	SITE#	TYP	WGHT	RM	MUNS-INT	MUNS-EXT	TH
R210	43A	R3798	SB	6.9	N	10 YR7/1	10 YR6/1	4
R210	43B	R3798	SB	7.3	N	10 YR6/2	10 YR5/1	4
R210	43C	R3798	SB	5.3	N	10 YR5/1	10 YR7/3	3
R210	A/1	R3798	SB	14.4	N	2.5YR5/6	10 YR6/6	6
*** Total ***								
				952.0				

Appendix K-3
An Assessment of the Potential National Register Eligibility of the Eagle Mountain Mine

Appendix K

An Assessment of the Potential National Register Eligibility of the Eagle Mountain Mine

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Introduction

Eagle Mountain Mine's eligibility for the National Register of Historic Places was raised as part of the scoping process for the proposed Eagle Mountain Landfill and Recycling Center Project. Subsequently, two studies were undertaken to address the National Register eligibility of the mine. In August, 1995, Greenwood and Associates (Schmidt, 1995) conducted an inventory of the Eagle Mountain Townsite adjacent to the mine and determined that the site was not eligible for the National Register. The second study, reported on here, addresses the potential eligibility of the mining and ore processing operation (references to "the mine" in this document include the processing facilities).

The current study included a field inspection of the mine, discussions with mine employees, and a review of pertinent literature. The operation of the Eagle Mountain Mine began in 1948 and continued through 1982. Properties that are less than 50 years old are generally not eligible for listing in the National Register. However, properties that do not meet the 50 year guideline can be listed if they can be shown to be of "exceptional importance". Therefore, a key element in this study is determining whether a reasonable case can be made that the mine meets the exceptional importance requirement. Two additional important elements in the National Register eligibility of any property are also discussed below. These are the significance and integrity of the mine. The findings of this study are summarized at the end of this document.

National Register Criteria

The National Register of Historic Places is a listing of historically significant properties that meet certain criteria. The quality of significance in American history, architecture, archaeology, and culture is present in districts, sites, buildings, structures, and objects of national, state, and local importance that possess integrity of location, design, setting, materials, workmanship, feeling, and association, and:

(a) that are associated with events that have made a significant contribution to the broad patterns of our history; or

(b) that are associated with the lives of persons significant in our past; or

(c) that embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; or

(d) that have yielded, or may be likely to yield, information important in prehistory of history.

Ordinarily, cemeteries, birthplaces, or graves of historical figures, properties owned by religious institutions or used for religious purposes, structures that have been moved from their original locations, reconstructed historic buildings, properties primarily commemorative in nature, and properties that have achieved significance within the past 50 years are not considered eligible for the National Register. However, such properties will qualify if they are integral parts of districts that do meet the criteria or if they fall within the following categories, called Criteria Considerations:

(a) a religious property deriving primary significance from architectural or artistic distinction or historical importance.

(b) a building or structure removed from its original location but that is significant primarily for architectural value, or that is the surviving structure most importantly associated with a historic person or event.

(c) a birthplace or grave of a historical figure of outstanding importance if there is no appropriate site or building directly associated with his productive life.

(d) a cemetery that derives its primary significance from graves of persons of transcendent importance, from age, from distinctive design features, or from association with historic events.

(e) a reconstructed building when accurately executed in a suitable environment and presented in a dignified manner as part of a restoration master plan, and when no other building or structure with the same association has survived.

(f) a property primarily commemorative in intent if design, age, tradition, or symbolic value has invested it with its own historical significance.

(g) a property achieving significance within the past 50 years if it is of exceptional importance.

General guidance for determining the National Register eligibility of a property is given in National Register Bulletin 15: *How to Apply the National Register Criteria for Evaluation.* Assessing the eligibility of a property less than 50 years old, such as the Eagle Mountain Mine, is provided in National Register Bulletin 22: *Guidelines for Evaluating and Nominating Properties that have Achieved Significance Within the Last Fifty Years.* This assessment of the potential National Register eligibility of the Eagle Mountain Mine was prepared following the guidance offered by those two bulletins.

Background

The presence of iron ore deposits in the Eagle Mountains had been known for several decades prior to the actual development of the Eagle Mountain Mine. Jack Moore, a resident of Banning, discovered the Eagle Mountain iron ore deposits in 1881 while prospecting in the area (Buie, 1964). While Moore filed a mineral claim, he did not keep up with the required assessment work and in 1895, L. S. Barnes of Mecca filed a claim on the ore deposit. Barnes kept up the required assessment work and in 1912 formed a syndicate including all of the claims in the Eagle Mountain area. Since Barnes owned 2/3 of the claims in the syndicate, it gave Barnes the exclusive option to act as its agent.

When Barnes learned that E. H. Harriman was having difficulty finding an economical supply of steel rails for his Southern Pacific Railroad, Barnes headed for New York. There Barnes sold Harriman the Eagle Mountain claims along with plans for an oil fired furnace for smelting the ore. Harriman never developed the property but did obtain property near San Pedro for a smelter site. It has been suggested that Harriman's purchase of the mining claims and smelter site were more a bluff to force price concessions from the steel industry than a legitimate attempt to develop a west coast steel industry.

In 1946, the mining claims were sold to Henry J. Kaiser by the estate of E. H. Harriman. Kaiser had been prominent in the construction industry in California but turned to ship building during World War II (Belden, 1964). However, Kaiser had difficulty in obtaining the necessary steel for large-scale ship building so he determined to construct a steel mill in California. He began a steel mill in Fontana, which was completed in December 1942. The mill initially operated on ore from the Vulcan mine but relied almost exclusively on ore from Eagle Mountain after the mine came into production. Construction of a 52-mile company railroad began shortly after Kaiser's acquisition of the property and was completed in 1948 (Thompson, 1992).

Production at the mine began in September 1948, and the first ore was shipped to Fontana the following month. The Eagle Mountain Mine was an open pit mine. The Bald Eagle pit was started in 1948 and had reached its planned depth by 1953 when the North-South Pit was opened (Carlisle, et al, 1954). The Black Eagle pit was opened in 1965 (Orlo Anderson, personal communication, 1995). By 1967, the Bald Eagle and North-South pits were combined and the East Pit remained (Drossel, 1967). The final pit was the Central, put into production in 1970.

Ore processing at the mine was in a nearly constant state of evolution. Initially, the ore went through a primary crusher at the mine before shipment to Fontana. In 1955, the first beneficiation facility was added to improve the grade of the ore being shipped. The facility included a three-stage crushing process and treatment with dry magnetic cobbing and heavy-medium. The facility had two major deficiencies: there was no treatment of fines and inadequate blending facilities. New facilities were completed in 1957 to address these deficiencies. The new facilities were highly automated and state of the art for the period (Thompson, 1992). By 1961, new primary and secondary crushers were installed. The final major improvement in the processing facility occurred in 1965 with the addition of a

pelletization plant. This facility was constructed in part to meet the needs of a contract to supply high grade to Japan.

Operation at the mine ended when the Fontana steel mill closed in 1982, largely a victim of lower cost foreign steel and iron ore. During its 34 years of operation, the mine produced 120,000,000 tons of iron ore. About 20,000,000 tons of ore and pellet were shipped to Japan and the rest was used at the Fontana mill (Thompson, 1992). The ore was shipped over the company owned railroad to Furrum where it was transferred to the Southern Pacific. Trains of 100 ore cars were the norm during peak production at the mine.

The mine was generally in the forefront of mining technology. In the mid 1960s it was among the largest open pit mines in the United States and had the largest ball mills in the world. The pelletizing plant built in 1965 was the largest in the world built around a single machine (Thompson, 1992). The mine was the first to use 100-ton semitrucks for hauling ore and was among the first to successfully use slurry blasting and down-the-hole drilling (Drossel, 1967).

Following closure of the mine, it was sold to a group of investors who began selling off everything they could. In 1986, all the equipment was sold to a used equipment company in Arizona. Between 1986 and 1991, most of the buildings were torn down and sold for scrap (Orlo Anderson, personal communication, 1995).

Today, the only component of the once extensive ore processing facility is the conveyor and shoot used to load the railroad ore cars, which were built in the mid 1960s (Orlo Anderson, personal communication, 1995). Several corrugated metal buildings are present near the rail line including the original mine office, which was later enlarged and converted to shop offices and storage; a large truck repair facilities (early 1960s); and an another facility that was used for locomotive repair and housed the electrical and machine shops (Late 1960s). A small, one story concrete block building (c. 1965) with a flat roof , located in the middle of the area once occupied by the processing facility, is surrounded by concrete footing. The ruins of the concrete pellet plant motor room are still present. What appear to be burn marks on the building is actually paint that was applied when the building was "blown up" during filming of a video for the "Terminator" movies. Other structures present include a few small, nondescript corrugated metal sheds and a metal tower atop a high peak that was used to control vehicle movements at the mine (Orlo Anderson, personal communication, 1995).

The mine was largely self-contained and appears to have had little long term impact on the surrounding area. Nearly all the development associated with the mine was located on the 5,500 acres mine site. The only major exception is the small residential community and golf course at Lake Tamarisk, which was developed for mine employees who wished to live outside the 400 acres townsite at the mine. The town site included a shopping center, post office, gas station, recreation hall, and churches. It also had its own school district. (See Schmidt, 1995 for an evaluation of the National Register eligibility of the town site.)

National Register Eligibility

The assessment of the potential National Register eligibility of the mine will focus on the significance of the property, its integrity, and whether it meets the criteria of "exceptional significance" required for properties less than 50 years old.

Significance

Significance is established under one or more the National Register Criteria for Evaluation. How the Eagle Mountain Mine meets each of these criteria is described below.

Criterion A - Association with Significant Events

An argument can be made for significance of Eagle Mountain Mine based on its role in iron ore mining industry in California, the United States, and the world. For much of their period of operation, the Eagle Mountain Mine and Fontana steel mill *were* the iron ore/steel industry in California. Other steel mills in the state operated on imported pig iron and scrap metal. However, the iron ore/steel industry was not a significant industry in California.

The Eagle Mountain mining operation was among the leaders in open pit iron ore mining during its 34 years of operation. It was among the largest mines of its time and regularly adopted the latest available technology. Much of the processing equipment was the largest of its kind in the United States, or in the world, when it was installed. Kaiser engineers designed and built the ore processing facility, piecing it together using equipment obtained from a variety of manufactures. It also was the first to adopt the 100 ton semitruck ore hauler and was an early user of 110 ton trucks. However, while Kaiser was in the forefront of adopting new and better technologies, the credit for advancement in mining technology goes to the manufacturers that developed the equipment, just as credit for development of the automobile assembly line goes to Henry Ford, not the person who bought the first car.

The mine was among the first mines to successfully use slurry blasting and down-the-hole drilling. While both were advancements in mining, these innovations did not constitute a major step forward and do not form a basis for establishing historic significance.

The construction of the railroad from Furrum to the mine did little, if anything, to encourage development of the region it traversed beyond development of the mine.

While steel produced from the mine's ore was used in the post-war development of California, it was far from the sole sources of steel and did not play a key role in that development.

While the mine operated during the Cold War Era, there is no information to suggest it played a role in any important Cold War events.

In summary, the establishment of historic significance of the mine under Criterion A may be possible based on its position as one of the larger mines in operation at that time. However, arguing for significance based primarily on size would be difficult. If the mine were

significant for its scale, the probable period of significance would be during its peak years of production in the mid 1960s. While the mine was quick to adopt advances in technology, credit for those advances goes to the developers of the equipment.

Criterion B - Association with Significant Persons

The Eagle Mountain Mine is associated with the productive life of Henry J. Kaiser. It is clear that Kaiser was an historically significant person. The mine illustrates the range of enterprises in which Kaiser engaged and has some potential for National Register listing based on that association. However, Kaiser appears to have had little direct involvement in the mine's operation. If the mine is significant for its association with Kaiser, its period of significance would probably be from the establishment of the mine in 1948 through Kaiser's death in 1967.

Criterion C - Illustrative of Design or Construction

The mining and ore processing operations at Eagle Mountain was large and often incorporated the latest advances in equipment. However, the open pit mines were continually expanded through 1982 and subsumed the earlier pits. Therefore, the mine is now illustrative of 1980s mining technology. In addition, all of the processing equipment and buildings were removed in the late 1980s. The mine has little potential for listing under Criterion C.

Criterion D - Information Content

It is highly likely that artifacts associated with the mining and processing operations are scattered across the property. It is just as likely that recovery of those artifacts would add little to our understanding of the mining operation provided in the extensive literature on Eagle Mountain. The Eagle Mountain Mine has little potential for listing in the National Register under Criterion D.

<u>Integrity</u>

Integrity is the ability of a property to convey its significance. This is a key factor in the National Register eligibility of the Eagle Mountain Mine. Virtually all of the ore extraction equipment and the processing facility were removed in the 1980s. All of the ore processing buildings were also removed and sold as scrap metal. As noted above, the ore pits underwent continual expansion and today are the product of mining activities in the early 1980s.

The removal of mining and processing equipment and buildings, and the continued expansion of the ore pits constitute important losses of integrity of design, materials, workmanship, and feeling. That loss of integrity makes it extremely difficult for the mine to convey any significance it may have. The property retains little of the character it had during the periods of potential significance identified above. Under Criterion A the facility would need to retain much of the features it had during its period of peak production in the middle 1960s. To have significance under Criterion B the mining/ore processing operation would need to appear much as it did during Kaiser's life.

The substantial loss of integrity suffered during expansion and subsequent demolition of the operation has virtually destroyed the properties ability to convey any historic significance it may have. Even if it were determined to be significant, its loss of integrity would probably foreclose National Register listing.

<u>Exceptional Importance</u>

The Eagle Mountain Mine is less than 50 years old so must meet the requirement of having "exceptional importance" as stated in Criterion Consideration G. Guidance for evaluating a property under that criterion states that "properties whose unusual contribution to the development of American history, architecture, archaeology, engineering, and culture can be clearly demonstrated" can be listed in the National Register (NPS, ND). The guidance further address what is need for a property to be considered of exceptional importance as follows:

> "...documentation for properties of recent significance *must* contain deliberate, distinct justification for the "exceptional" importance of the resources...[It] must make a persuasive, direct case that the grounds - the context - for evaluating a property's exceptional importance exist and that the property being nominated is, within that context, exceptional (NPS, ND)."

For the mine to be eligible for National Register listing under Criteria A, it would be necessary to establish than post-war iron ore mining was an activity of major historic importance and that the Eagle Mountain Mine was of exceptional importance within the context of post-war mining. While post-war iron ore mining is an important industry, it is not widely considered to be of great historic significance nor can the Eagle Mountain Mine be shown to have been "exceptionally important" to that industry.

For the mine to be eligible under Criterion B, the life's work of Henry J. Kaiser would need to be shown to be of great historic significance and the Eagle Mountain Mine would have to hold a position of exceptional importance in Kaiser's legacy. Henry J. Kaiser was a prominent figure during World War II and probably qualifies as a significant person under Criterion B. However, it cannot be demonstrated that the Eagle Mountain Mine was of such exceptional importance in his life's accomplishments that it should be listed in the National Register despite its age.

The Eagle Mountain Mine does not appear to meet the require of exceptional significance necessary for National Register listing of properties that have achieved significance within the last 50 years.

Summary

The potential for listing the Eagle Mountain Mine on the National Register of Historic Places appears extremely limited. It may possess significance Under Criterion B for its associated with Henry J. Kaiser from 1948-1967. There is also some possibility the mine may be significant under Criterion A for the role it played in iron ore extraction and processing in the middle 1960s.

The mine and processing facilities have undergone substantial loss of integrity since the possible periods of significance. Mining continued into 1982 and the ore pits represent the mine as it was at that date. In addition, virtually all of the mining and processing equipment and buildings are no longer present, having been removed in the late 1980s. The loss of integrity makes it nearly impossible for the mine to convey any historic significance it may have.

The any significance the mining and processing operation may possess was achieved less than 50 years ago. Evidence examined as part of this study indicate that the property does not meet the requirement of possessing exceptional importance necessary for listing of recent properties on the National Register.

The Eagle Mountain Mine does not appear to be eligible for listing in the National Register.

Recommendations

The Eagle Mountain Mine does not appear to be eligible for National Register listing because of a significant loss of integrity and the improbability that the mine would meet the requirement of exceptional importance contained in Criterion Consideration G. Further efforts to establish the National Register eligibility of the mine do not appear warranted and are not recommended.

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Appendix L
Updated Paleontological Resource Assessment

PALEONTOLOGIC RESOURCE ASSESSMENT

EAGLE MOUNTAIN MINE SOLID WASTE DISPOSAL SITE

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for

RECON
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December, 1989

Paleontologic Resource Assessment
Eagle Mountain Mine (MRC)

INTRODUCTION

Mine Reclamation Corporation (MRC) proposes to utilize a portion of the Eagle Mountain open pit mine as a regional solid waste disposal site. The usage in part includes retrieving recyclable materials. The proposal includes utilization of a portion of the Eagle Mountain mine as a land fill as well as access by road and access by the Kaiser Railroad. These are discussed herein as follows:

1a. Mine/landfill site, 1,650 acres

1b. Kaiser Road, 5 mile access

1c. Kaiser Railroad north of Interstate 10, approximately 12 miles, and

2. Kaiser Railroad south of Interstate 10, approximately 40 miles.

This paleontologic resource assessment includes a review of pertinent geologic literature and a check of paleontologic resource locality records in the Regional Paleontologic Locality Inventory at the San Bernardino County Museum. Based on this review, a preconstruction field survey of sensitive portions of the mine site, access roads, and railroad right of way was conducted to provide information on which a detailed plan for mitigation could be developed.

The area under assessment consists of two distinct geologic and geographic areas: the area north of Interstate 10 and the area south of Interstate 10. This report is divided into sections reflecting these distinct areas.

METHODS

The review of geologic literature was conducted in the library of the Earth Sciences Division at the San Bernardino County Museum, in the University of California, Riverside Department of Earth Sciences library, and in the personal reference collections of the author. The review of resource localities was conducted at the Regional Paleontologic Locality Inventory of the San Bernardino County Museum, the site files of the University of California, Riverside, and paleontologic site records from the Natural History Museum of Los Angeles County (LACM), Section of Vertebrate Paleontology.

The field survey was directed by Robert E. Reynolds, Curator of Earth Sciences, San Bernardino County Museum. Mr. Reynolds has had more than 25 years of field experience in paleontologic survey, assessment, and salvage in southern and central California, including San Bernardino, Riverside, and Imperial counties. He was assisted by Quintin Lake, James Steinmetz, James Bowden, Allen Tedrow, and Kathleen Springer, all employees of the Earth Sciences Division of the San Bernardino County Museum and each with experience in paleontologic resource

assessment in Riverside and San Bernardino counties. The survey was conducted between November 30 and December 8, 1989. Field work was conducted under Bureau of Land Management paleontologic permit CA881416 with a Fieldwork Authorization Permit issued by the Bureau of Land Management, Indio Resource Area, Russell Kaldenberg, Area Manager.

Field work was conducted by teams who traversed portions of the parcels on foot at 30 meter intervals with intuitive deviations to inspect likely looking outcrops of sediments at the Eagle Mountain mine and along rights of way to the mine, which include the Eagle Mountain Road and the Kaiser Railroad. Teams of two persons paralleled the right of way center line, inspecting outcrops in washes and sediments exposed in railroad cuts and in access road cuts.

NORTH OF INTERSTATE 10

Location

The Eagle Mountain mine site, including the proposed land fill location, the Kaiser access road, and approximately 12 miles of the Kaiser Railroad are located north of Interstate 10 between Indio and Blythe. This portion is treated in one section because of similarities of geologic units.

1a. Mine/Disposal Site is located in portions of:

sections 25, 26, 27, 28, 33, 34, 35, 36, T.3S, R.14E;

section 31, T.3S, R.15E;

section 6, T.4S, R.15E; and

sections 1, 2, 12, T.4S, R.14E,

as shown on the Pinto Wells 7.5', Coxcomb Mountains 7.5', Victory Pass 7.5', and Buzzard Spring 7.5' quadrangle maps.

1b. Eagle Mountain Road is the proposed truck access, running north from Interstate 10. The north portion of this road may be relocated parallel to a proposed spur of the Kaiser Railroad. From the north, the access road crosses portions of:

sections 6, 7, 17, 18, 19, 20, 30, 31, T.4S, R.15E;

sections 6, 7, 18, 19, 30, T.5S, R.15E, SBBM

as shown on the Victory Pass 7.5' and Desert Center 7.5' quadrangle maps.

1c. Kaiser Railroad north of Interstate 10 runs to the Eagle Mountain mine. For clarity, the portion of the railroad north of Interstate 10 is discussed here; discussion of the portion of the railroad south of Interstate 10 follows. Kaiser Railroad north of Interstate 10 crosses the following sections:

sections 1, 2, 11, T.4S, R.14E SBBM;

sections 6, 7, 17, 18, 19, 20, 30, 31, T.4S, R.15E;

sections 12, 13, 23, 24, 26, 27, 28, 29, 31, 32, T.5S, R.14E; and

section 6, T.6S, R.14E, SBBM

as shown on the Victory Pass 7.5', Desert Center 7.5', and

Hayfield Spring 7.5' quadrangles.

Impacts

Impacts to sediments containing nonrenewable paleontologic resources may occur through project development and use.

1a. Mine/Landfill site. Proposed areas for fill, new structures, and laydown and staging areas would be developed by grading and excavation which could produce impacts to nonrenewable paleontologic resources in sedimentary rocks.

1b. Eagle Mountain Road. Upgrading, realignment, and development of drainage structures would involve excavation. Annual maintenance with excavation equipment might impact nonrenewable paleontologic resources in sedimentary rock units.

1c. Kaiser Railroad North. The rebuilding of the railroad grade, the addition of the proposed spur, development of new drainage structures and access roads, and annual maintenance would all be done with excavation equipment. Excavation into sediments could produce impacts to nonrenewable paleontologic resources.

Resources

The project includes the proposed disposal site at the Eagle Mountain mine, the truck access by Eagle Mountain Road, and approximately 12 miles of Kaiser Railroad lie north of Interstate 10 as it runs east/west between Chiriaco Summit and Desert Center. Rock units in this area are similar, and are discussed separately from rocks south of Interstate 10.

Geologic mapping summarized by C.W. Jennings (1967) indicates that the following rock types occur at the site and along the rights of way.

Gneissic rocks are of high metamorphic grade and have been subject to severe deformation. These rocks may range in age from Proterozoic to early Mesozoic. However, recrystallization involved in their formation precludes preservation of fossils.

Granitic rocks are late Mesozoic in age and because of their intrusive nature are in part responsible for the deformation of the metamorphic rocks listed above. Their mode of emplacement and crystallization precludes preservation of fossils.

Volcanic rocks north of Interstate 10 may be early to middle Miocene in age, circa 20 million years (m.y.), assuming that they are from the same volcanic event that took place in the Orocopia Mountains. The volcanic rock are not associated with sediments or volcaniclastic debris flows and consequently they have a low potential to contain vertebrate fossils. The proposed rights of way will not cross the Tertiary volcanic rocks.

Pleistocene alluvium occurs as dissected fanglomerates and terraces within the project area. These are expected to contain coarse, angular rocks near their source and grade into finer sediments away from their source. The potential for vertebrate fossils in these sediments would increase away from source as sediment clast size became finer and as sediments became stable and developed soil horizons.

Recent alluvium is located in valleys and in wash bottoms between outcrops of the above rock types. These recent, active sediments have low potential to produce paleontologic resources.

Review of the Regional Paleontologic Locality Inventory at the San Bernardino County Museum, and the paleontologic locality records at U.C. Riverside and from the Los Angeles County Museum of Natural History do not indicate that previous paleontologic assessments have been conducted at or near the Eagle Mountain mine site or along the road and railroad rights of way north of Interstate 10. Consequently, no paleontologic resource sites are known from the two sedimentary units encountered by the proposed project.

Results of Field Survey

Field survey was conducted along the road and railroad rights of way north of Interstate 10 and on portions of the Eagle Mountain Mine/proposed landfill site which contained Pleistocene alluvial sediments. Pleistocene alluvium at the eastern portion of the land fill site is very coarse and has a low potential to

contain nonrenewable paleontologic resources. No impacts to paleontologic resources are expected during construction excavation related to the development of the proposed land fill or its operation at the Eagle Mountain mine.

The Kaiser Railroad north of Interstate 10 crosses and cuts through coarse Pleistocene fanglomerate. The high-energy method of emplacement of this coarse fanglomerate is not conducive to the preservation of paleontologic resources and the potential for their occurrence is low. No impacts from railroad grade construction of annual maintenance are expected.

Eagle Mountain Road runs north from Interstate 10 and crosses Recent alluvium and older Pleistocene alluvium. The Pleistocene alluvium crossed by Eagle Mountain Road is coarse, indicating high-energy deposition which is generally not conducive to the preservation of vertebrate fossils. Excavation related to road widening and annual maintenance in not expected to produce impacts to paleontologic resources along Eagle Mountain Road north of the Cal Trans right of way associated with Interstate 10.

However, within the Cal Trans right of way at the junction of Eagle Mountain Road and Interstate 10, and to the south of Interstate 10, are sediments conductive to the preservation of vertebrate fossils. These are moderately coarse to fine grained Pleistocene alluvial sediments which contain several horizons of loamy calichified soil with occasional calichified burrows and root casts. These deposits indicate stable alluvium that was

receiving fine-grained sediments and which developed soil profiles, including calichification. The sediments are located on both sides of Eagle Mountain Road and within the fenced Cal Trans right of way, and include the access ramps to Interstate 10. Sediments extend southerly out of the Cal Trans right of way. If road construction and realignment is considered for this portion of Eagle Mountain Road near Interstate 10, a program to mitigate impacts to nonrenewable paleontologic resources should be developed for specific excavation plans.

SOUTH OF INTERSTATE 10

Location

2. Kaiser Railroad South of Interstate 10 runs from the Chuckawalla Valley across the Chuckawalla Bench to Chuckawalla Summit. It then parallels Salt Creek as it runs south of the Orocopia Mountains and north of the Chocolate Mountains. The Coachella branch of the All American Canal is near the elevation of the high shoreline of ancient Lake Cahuilla. Near this point, the Kaiser Railroad is north of Salt Creek and runs southwesterly to its terminus at Ferrum, on Highway 111 on the east side of the Salton Sea. The Kaiser Railroad crosses the following sections south of Interstate 10 to Ferrum on Highway 111.

sections 6, 7, 8, 9, 16, 17, 21, 28, 33, T.6S, R.14E;

sections 5, 7, 8, T.7S, R.14E;

sections 12, 13, 14, 21, 22, 23, 28, 29, 31, 32, T.7S,

R.13E;

sections 34, 35, 36, T.7S, R.12E;

sections 3, 7, 8, 9, 10, T.8S, R.12E; and

sections 12, 13, 14, 20, 21, 22, 23, 27, 28, 29, T.8S, R.11E

as shown on the Hayfield Spring 7.5', East of Red Canyon 7.5', Red Canyon 7.5', Frink NW 7.5', and Durmid 7.5' quadrangles.

Impacts

2. Kaiser Railroad South. The rebuilding of the railroad right of way and grade, the development of new drainage structures and access roads, and annual maintenance would all be done with excavation equipment. Excavation for cuts within rights of way or excavation for fill outside of the reviewed rights of way could produce impacts to nonrenewable paleontologic resources in sensitive sedimentary deposits.

Resources

Lithologic units south of Interstate 10 are discussed below.

Gneissic rocks of high metamorphic grade in the eastern Orocopia Mountains, western Chuckawalla Mountains, and western Chocolate Mountains are referred to as "Precambrian" age by Jennings (1967) and may be older than 500 million years. The high grade of crystallization and severe deformation precludes preservation of fossils.

Orocopia Schist in the south and western Orocopia Mountains is now considered to be Mesozoic in age (Crowell and Walker, 1962). The Orocopia Schist figures prominently in discussions of amount of offset along the San Andreas Fault. The high degree of crystallization and deformation precludes preservation of fossils.

Granitic rocks span a period of time that includes the late Mesozoic. Their mode of emplacement and crystallization precludes preservation of vertebrate fossils.

The Maniobra Formation of Eocene age (Crowell, 1962; Crowell and Susuki, 1959)contains an important assemblage of invertebrate fossils which includes four gastropods and two pelecypods. The Maniobra Formation plays an important part in discussions of offset along the San Andreas Fault. The Maniobra Formation has the potential to contain vertebrate fossils. The Kaiser Railroad right of way and access roads will not come into contact with the Maniobra Formation.

The Diligencia Formation is now considered to include the Late Arikareean land mammal age of the early Miocene (Woodburne and Whistler, 1973). The following localities have produced vertebrate fossils:

LACM V7114	Merychyus calaminthus	oreodont
UCRV 7901	Stenomylus sp.	small camel

The vertebrate fossils provide age control for the continental sediments of the Diligencia Formation which figures prominently

in the discussions of offset distances and rates along the San Andreas Fault. The fossil localities are approximately 2/3 mile distant from the Kaiser Railroad right of way and the formation itself is not encountered by the railroad right of way.

Tertiary volcanics interfinger the early Miocene Diligencia Formation and are mapped as being in the Upper Diligencia or overlying the Diligencia Formation within the Orocopia Mountains. To the southeast, in the Chocolate Mountains, Tertiary volcanics are mapped as sitting within or on top of Pliocene or Pleistocene fluviatile sediments on the northeast side of the San Andreas Fault. The volcanic rocks may provide datable horizons within the sedimentary units between early Miocene and late Pliocene times. These volcanic units south of Interstate 10 are generally associated with sedimentary units which have potential to contain vertebrate fossils. The Kaiser Railroad will not directly cross Tertiary volcanic rocks but is cut into sedimentary units which may interfinger with these volcanic sediments.

Pleistocene old alluvium. Fluviatile sediments include coarse fanglomerates and fine-grained fluviatile sediments which occur along the Kaiser Railroad right of way. These fluviatile sediments are coarse near their source and grade to finer sediments with soil horizons near the valley centers. In the northern Chocolate Mountains and in the western Chuckawalla Mountains, geologic mapping has distinguished older Pleistocene alluvial deposits from Pleistocene alluvium. Field relationships suggest that the latter is younger than the former. The field

assessment determined that the Kaiser Railroad runs through moderately coarse to fine fluviatile sediments with several very well developed red loamy soil horizons. These are probably equivalent in age and may be distal depositional equivalents to the Pleistocene old alluvium mapped to the south and east. The Pleistocene old alluvium along the railroad right of way is distinguished from younger Pleistocene alluvium by deep weathering and because it may be somewhat deformed and may contain fault offsets that are not seen in the younger Pleistocene alluvium. Fine-grained portions of the Pleistocene old alluvium and the soil horizons have potential to contain paleontologic resources. Although no vertebrate fossils were located during the field survey, soil horizons have been shown to be relatively fossiliferous compared to coarse fluviatile deposits (Reynolds, 1985; Woodburne and Golz, 1972). The potential for paleontologic resources was reinforced during the field assessment when calichified casts of roots were located in the red soil horizons. A list of these sites includes:

SBCM 05.013.001	Chuckawalla Summit Sediments #1	root casts
SBCM 05.013.002	Chuckawalla Summit Sediments #2	root casts
SBCM 05.013.003	Chuckawalla Summit Sediments #3	root casts
SBCM 05.013.004	Chuckawalla Summit Sediments #4	root casts
SBCM 05.013.005	Chuckawalla Summit Sediments #5	root casts

The Pleistocene old alluvium along the Kaiser Railroad has potential to produce nonrenewable paleontologic resources. These resources may be impacted by excavation related to railroad rehabilitation and maintenance. A program to mitigate impacts to nonrenewable paleontologic resources is presented herein.

<u>Pleistocene alluvium</u>. Pleistocene fanglomerates and fluviatile sediments are mapped as occurring along the Kaiser Railroad right of way. These sediments are light gray in color and may sit unconformably upon the redder Pleistocene old alluvium. Along the railroad, these sediments are very coarse and consequently have a low potential to contain nonrenewable paleontologic resources.

<u>Pleistocene lacustrine sediments</u>. Pleistocene lacustrine deposits and interbedded fluviatile deposits are found above the high shoreline of Lake Cahuilla westward to the current shoreline of the Salton Sea. These in part are covered by a thin veneer of sediments from Holocene Lake Cahuilla and deltaic sediments from the Colorado River. However, downcutting wave action of Lake Cahuilla has exposed the Pleistocene lacustrine sediments over a broad area. The older sediments show deformation near the trace of the San Andreas Fault. North of Bombay Beach at Salt Springs, these older Lake sediments are nearly vertical and contain the Bishop Tuff, dated at 740,000 ybp (Rymer, 1989). Lacustrine sediments of the Borrego Formation, named from deposits on the west side of the Salton Sea, may be correlative with these older Quaternary lake sediments.

These tan to red older Pleistocene lake sediments are flat-lying or deformed, depending on their proximity to the San Andreas Fault. Therefore, a broad range of time may be represented by these vertical sediments near the fault branches and those flat-lying sediments that are relatively undeformed.

Their ages may range from middle Pleistocene at Bombay Beach, where the Bishop Tuff is exposed (74,000 ybp, Rymer 1989) to less than 35,000 ybp (K. Sieh, California Institute of Technology, personal communication to Reynolds, 1987; Reynolds, 1987a, 1989). North of Wister, the flat-lying sediments contain an articulated limb of <u>Equus</u> sp. (small), a Pleistocene horse.

Review of the Regional Paleontologic Locality Inventory at the San Bernardino County Museum identified the following resource localities in the vicinity of the Kaiser Railroad where sediments are exposed west of the Coachella Canal to the margin of the Salton Sea.

SBCM 05.012.001	Salt Creek #1	articulated <u>Anodonta</u> sp; 3 species of gastropods
SBCM 05.012.002	Salt Creek #2	fish, <u>Physa</u> sp., conispiral gastropods
SBCM 05.012.003	Salt Creek #3	fish, articulated <u>Anodonta</u> sp, <u>Physa</u> sp, conispiral gastropods
SBCM 05.012.004	Salt Creek #4	<u>Anodonta</u> sp, gastropods
SBCM 05.012.005	Salt Creek #5	fish, gastropods
SBCM 05.012.006	Salt Creek #6	<u>Anodonta</u> sp, <u>Physa</u> sp.
SBCM 05.012.007	Salt Creek #7	<u>Anodonta</u> sp, <u>Physa</u> sp.
SBCM 05.012.008	Frink Mineral Springs #1	<u>Anodonta</u> sp, several species of gastropods
SBCM 05.012.009	Frink Mineral Springs #2	Pelecypod (large species)
SBCM 05.012.010	Frink MIneral Springs #3	fish, large mammal, gastropod species including <u>Physa</u> sp.
SBCM 05.012.011	Frink Mineral Springs #4	fish, <u>Corbicula</u>

		sp, several species of gastropods
SBCM 05.012.012	Frink	_Anodonta_ sp, _Corbicula_ sp.
SBCM 05.012.013	Salt Creek N. #4	fish, ostracodes
SBCM 05.012.015	Salt Creek N, #6	_Tryonia_ sp, _Gyraulus_ sp.
SBCM 05.012.016	Salt Creek N. #7	_Tryonia_ sp, ostracodes
SBCM 05.012.017	Salt Creek N, #8	ostracodes
SBCM 05.012.018	Salt Creek N. #9	Charophyta, _Anodonta_ sp., _Physella_ sp, Hydrobiidae, _Amnicola_ sp, fish
SBCM 05.012.020	Salt Creek N. #11	fish, ostracodes
SBCM 05.012.021	Salt Creek S. #2	_Solen_ sp.

Results of Field Survey

The field survey along the Kaiser Railroad reinforces the fossiliferous nature of the sediments between the Coachella Canal and Highway 111. The following resource localities were recorded during the field assessment.

SBCM 05.012.030	Salt Spring RR #1	_Anodonta_ sp, _Physa_ sp, _Tryonia_ sp.
SBCM 05.012.031	Salt Spring RR #2	_Lepus californicus_
SBCM 05.012.032	Salt Spring RR #3	_Anodonta_ sp, _Tryonia_ sp.
SBCM 05.012.033	Salt Spring RR #4	marine? pelecypods
SBCM 05.012.034	Salt Spring RR #5	_Anodonta_ sp, marine? pelecypod
SBCM 05.012.035	Salt Spring RR #6	_Anodonta_ sp.
SBCM 05.012.036	Salt Spring RR #7	_Anodonta_ sp, marine? pelecypod

SBCM 05.012.037	Salt Spring RR #8	<u>Anodonta</u> sp. <u>Tryonia</u> sp, <u>Physa</u> sp.
SBCM 05.012.038	Salt Spring RR #9	fish, <u>Anodonta</u> sp, <u>Physa</u> sp, <u>Tryonia</u> sp.
SBCM 05.012.039	Salt Spring RR #10	<u>Anodonta</u> sp, <u>Physa</u> sp, <u>Helisoma</u> sp.
SBCM 05.012.040	Salt Spring RR #11	large mammal bone, <u>Helisoma</u> sp.
SBCM 05.012.041	Salt Spring RR #12	<u>Anodonta</u> sp, <u>Physa</u> sp, <u>Tryonia</u> sp, <u>Helisoma</u> sp.
SBCM 05.012.042	Hunters Spring #1	<u>Physa</u> sp, <u>Tryonia</u> sp.
SBCM 05.012.043	Hunters Spring #2	<u>Anodonta</u> sp, <u>Physa</u> sp, <u>Tryonia</u> sp.
SBCM 05.012.044	Hunters Spring #3	<u>Anodonta</u> sp, <u>Physa</u> sp.
SBCM 05.012.045	Hunters Spring #4	<u>Anodonta</u> sp, <u>Tryonia</u> sp, <u>Physa</u> sp.
SBCM 05.012.046	Hunters Spring #5	fish, <u>Physa</u> sp, <u>Tryonia</u> sp.

Pleistocene lacustrine sediments along the Kaiser Railroad west of the Coachella Canal and the terminus of the railroad at Ferrum have potential to contain nonrenewable paleontologic resources. Impacts to these resources may occur due to excavation-related to railroad rehabilitation and maintenance. A program to mitigate impacts is proposed herein.

Recent alluvial sediments occur on slopes covering the above-listed rock units as well as in active washes located centrally in valleys. These recently active sediments have low potential to contain paleontologic resources.

SUMMARY OF FINDINGS

Sedimentary rocks with high potential to contain nonrenewable paleontologic resources occur at the Interstate 10 junction with Eagle Mountain Road and south of Interstate 10 in several sedimentary units along the Kaiser Railroad. Locations of sensitive sedimentary units are described herein and are shown on the accompanying sensitivity map.

Rock Units with Paleontologic Sensitivity

I-10 & Eagle Mt. Road	Pleistocene Old Alluvium (Qoa)	S/2 SE/4 sec. 30, T.5S R.1E (Desert Center 7.5')
Red Cloud Mine Junction	Qoa	SW/4 sec. 9, T.6S R.14E
Chuckawalla Summit Sediments	Qoa	secs 5, 7, 8, T.7S R.14E secs 12, 13, 14, T.7S R.13E
Hunters Spring	Pleistocene lacustrine	sec 7, T.8S R.12E; sec. 12, 13, 14, 20, 21, 22, 23, 27, 28, 29, T.8S R.11E

RECOMMENDATIONS

The above-listed portions of right of way associated with the Eagle Mountain mine reclamation plan crosses sediments with high potential to produce nonrenewable paleontologic resources. Twenty-three resource sites were located along the right of way during the field survey. Right of way improvements and maintenance may involve excavation directly as sediments with the right of way or for recovery of foil near the right of way. Excavation has the potential to impact nonrenewable paleontologic resources. A program to mitigate impacts to paleontologic resources is proposed in accordance with Federal and State guidelines and legislation for the preservation of significant nonrenewable paleontologic resources. The program outlined below is general for the right of way and will need to be applied to specific excavation proposals, such as borrow pits, when these are specified. The general program to mitigate impacts to nonrenewable paleontologic resources includes:

1. Pre-excavation survey to recover paleontologic resources exposed in areas of proposed excavation.

2. Monitoring of excavation by qualified paleontologic monitors to salvage resources as they are uncovered by excavation. This includes the recovery, removal, and processing of adequate samples of sediments containing small to microscopic vertebrate fossils. Monitors should be equipped to salvage fossils as they are unearthed, without unnecessary delays to excavation schedules. Monitors must be empowered to temporarily

halt or divert construction equipment if necessary to remove large or abundant fossil specimens.

3. Preparation of fossils to a point of identification. This includes wet screening of matrix containing fossils to recover small to microscopic vertebrate remains from sediments. Matrix must be removed from large specimens to reduce volume during storage. Specimens should be prepared to a point of stabilization and identification.

4. Identification of specimens, curation, and storage in an established repository with retrievable collections.

5. Preparation of a report of findings, including an itemized inventory of specimens accessioned into the museum's collections.

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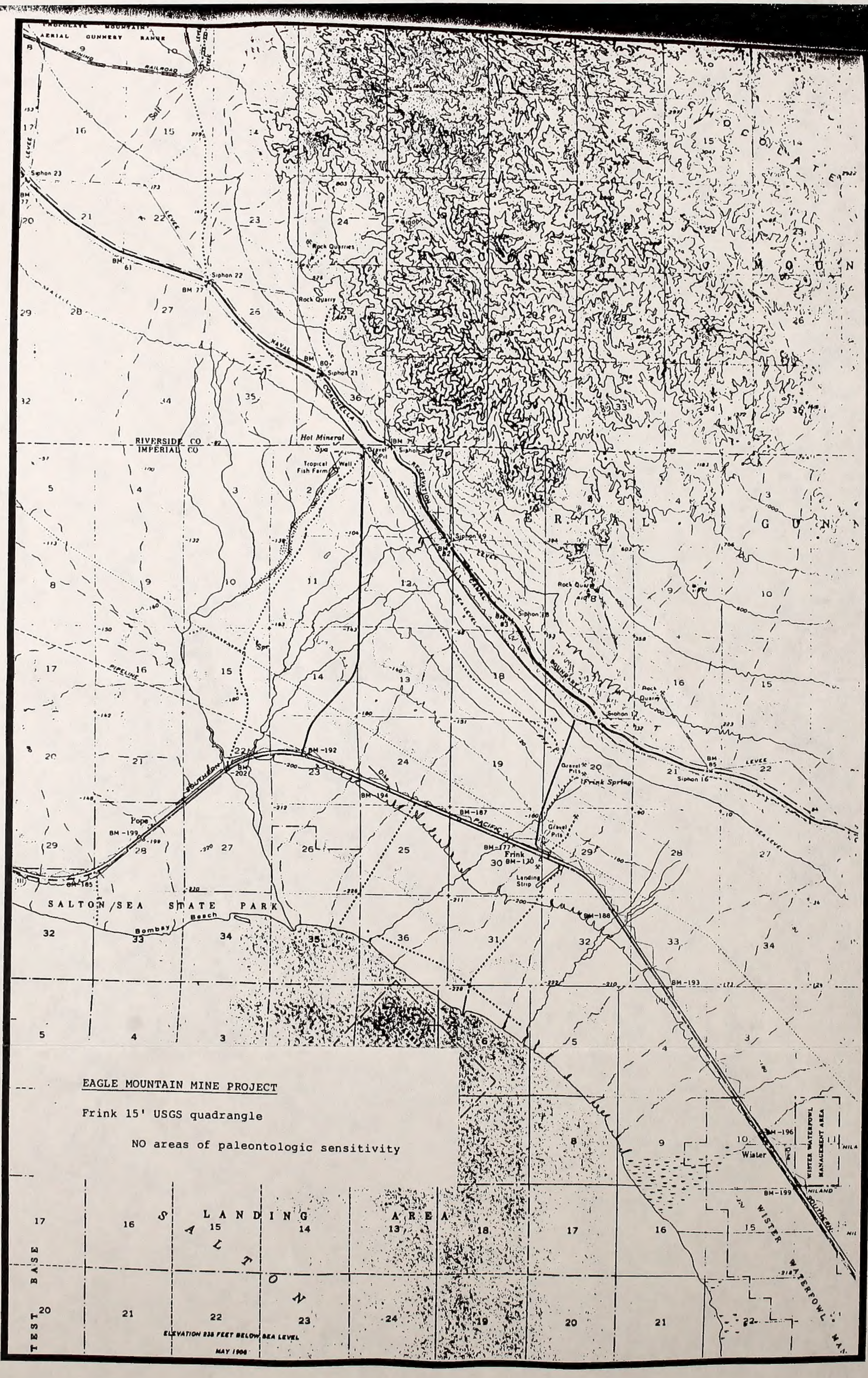
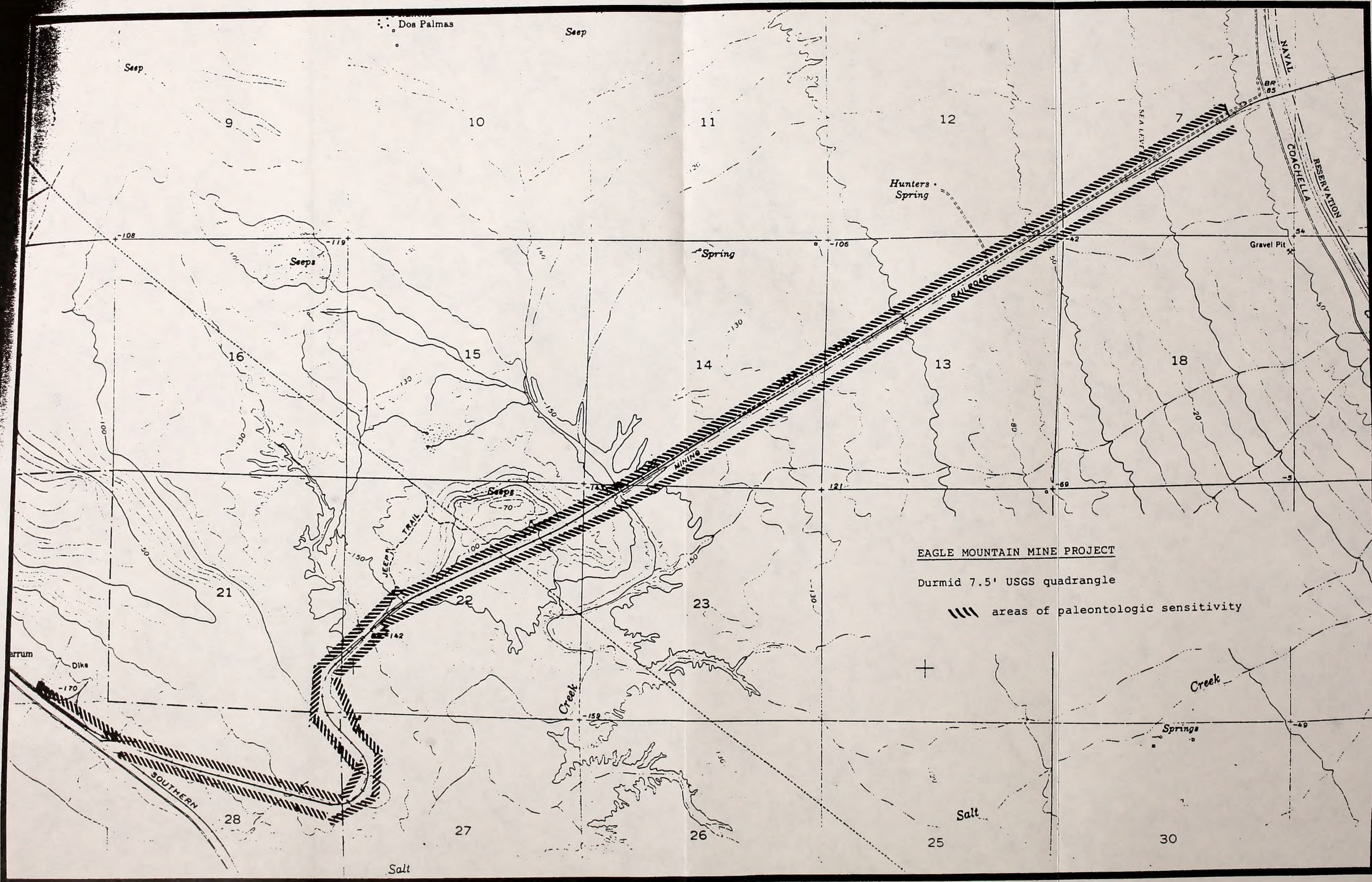
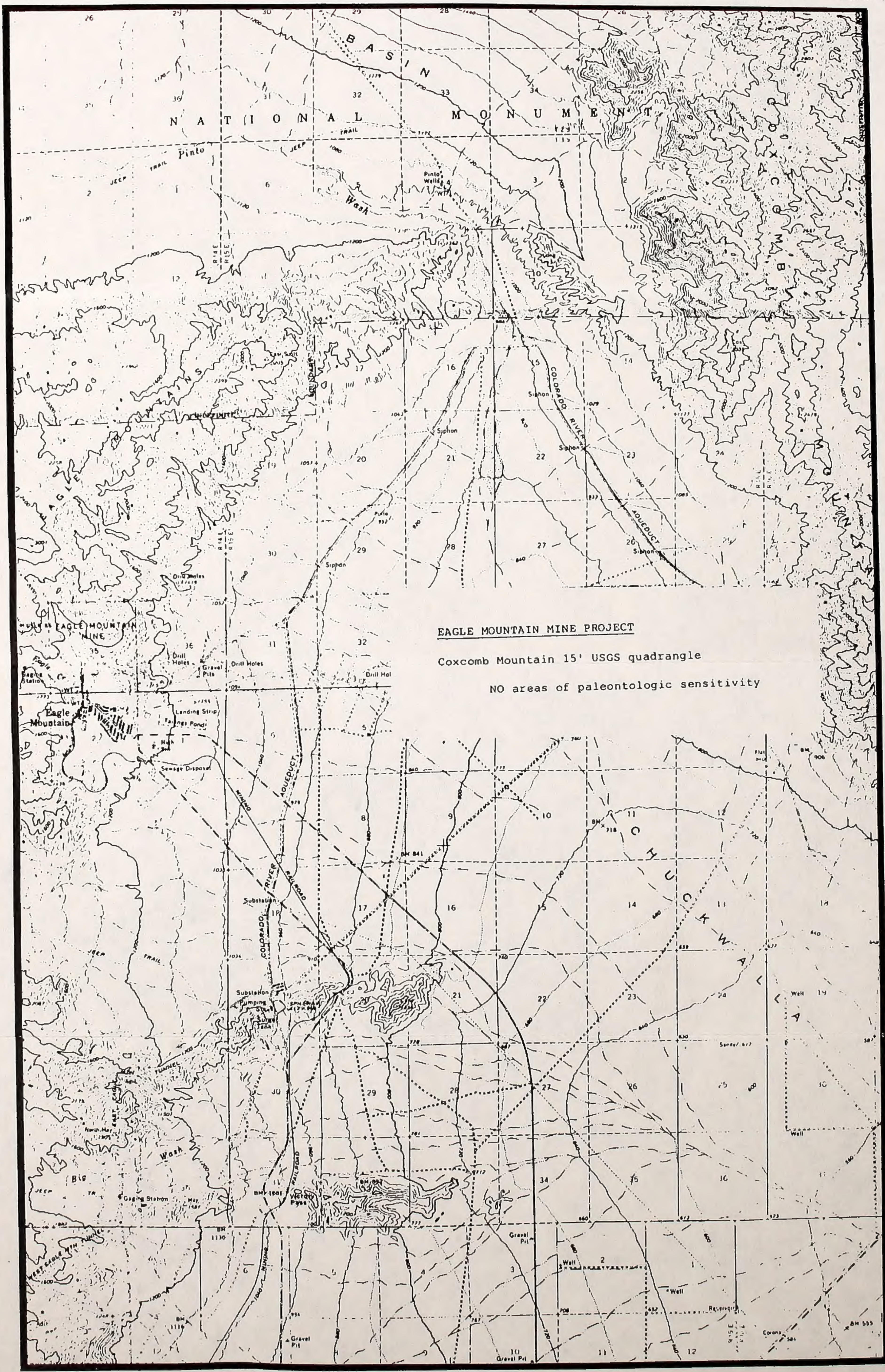


EAGLE MOUNTAIN MINE PROJECT

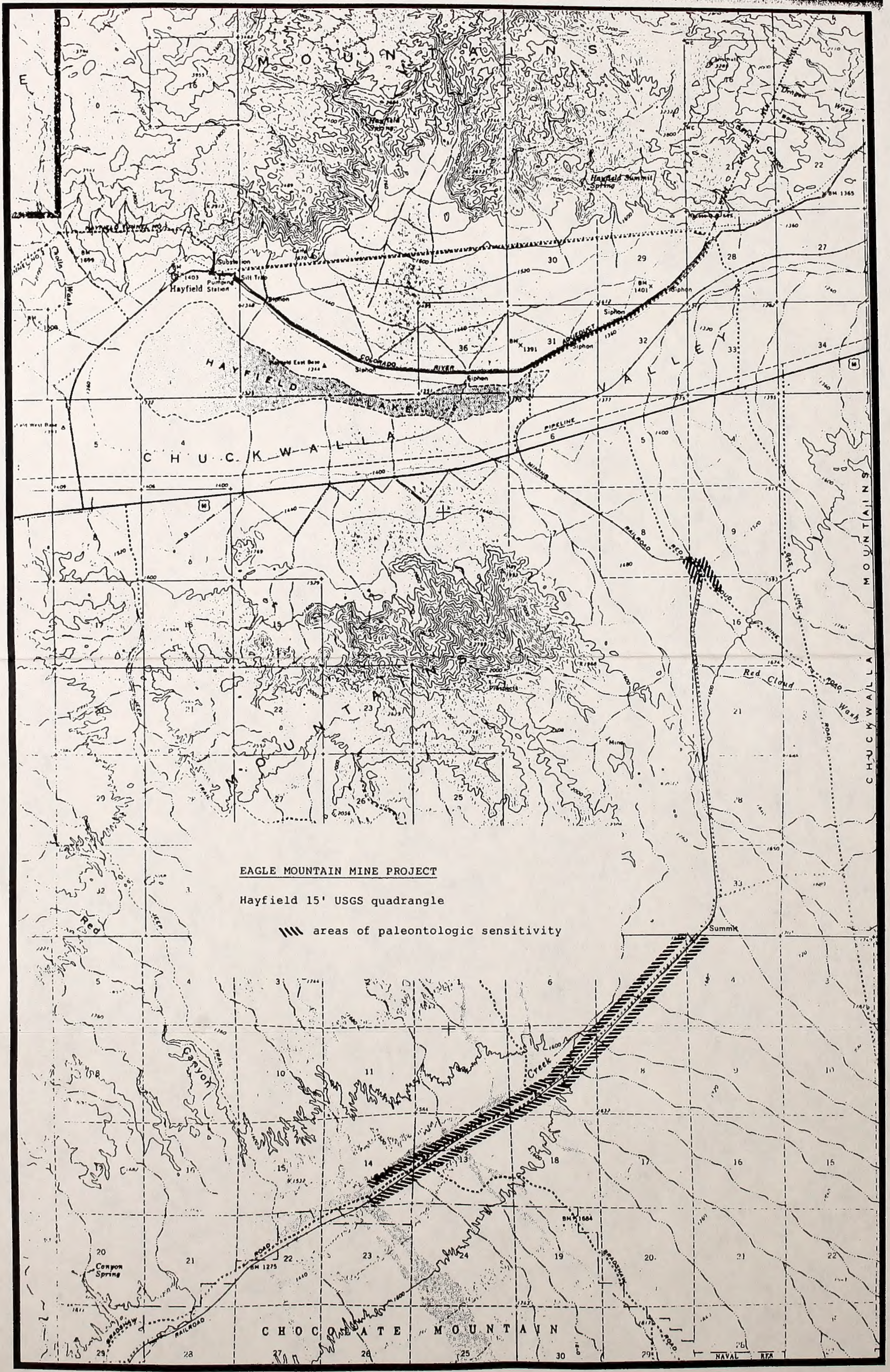
Frink 15' USGS quadrangle

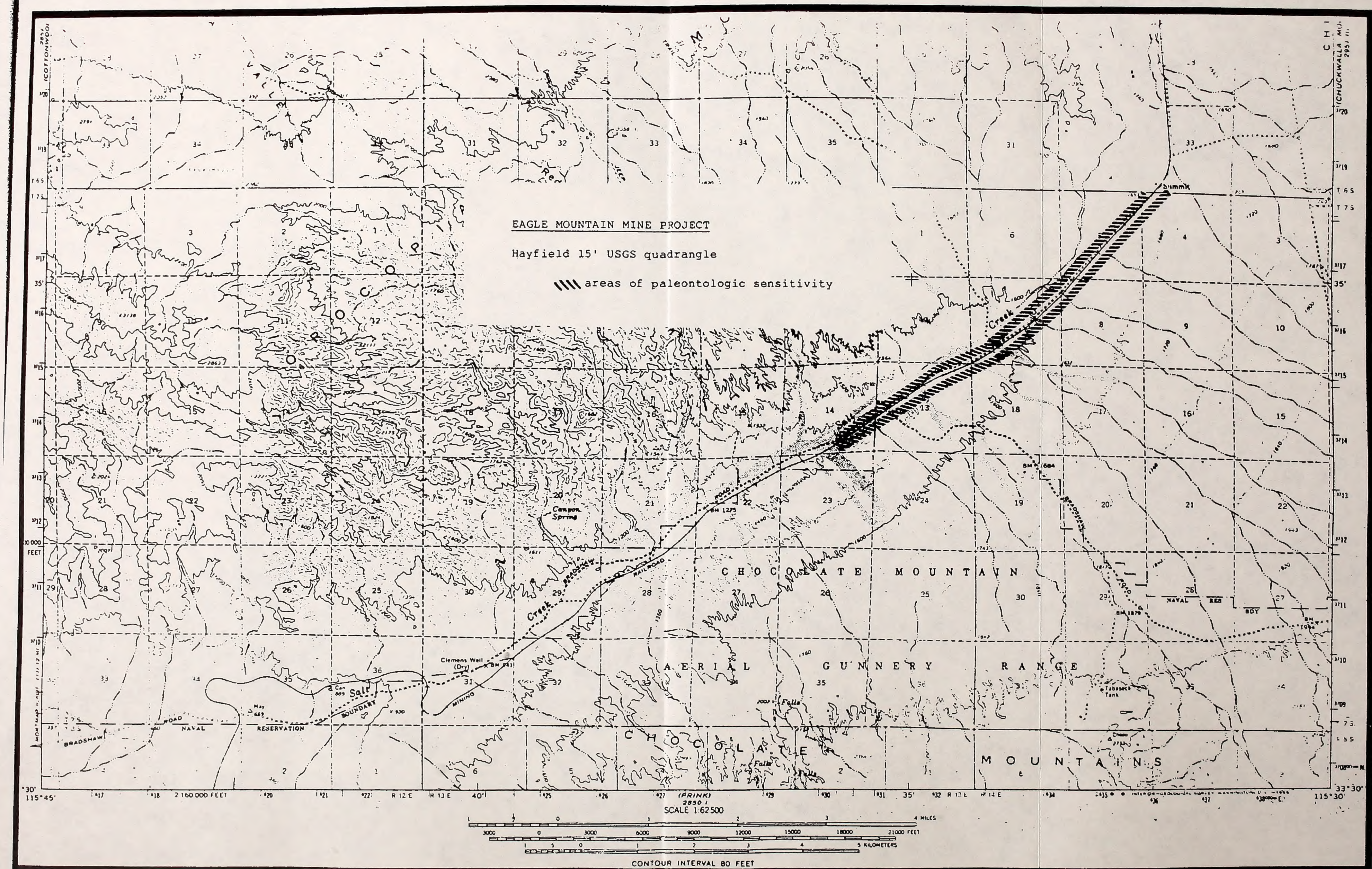
NO areas of paleontologic sensitivity


Dos Palmas
Seep
Seep
9
10
11
12
7
NAVAL
RESERVATION
COACHELLA
BR 85
Hunters Spring
-108
-119
-106
-42
54
Gravel Pit
Seeps
Spring
RAILROAD
MINING
16
15
14
13
18
Seeps
JEEP TRAIL
-69
121
21
22
23
142
EAGLE MOUNTAIN MINE PROJECT
Durmid 7.5' USGS quadrangle
areas of paleontologic sensitivity
Dike
-170
SOUTHERN
Creek
-159
Creek
Springs
-49
28
27
26
25
30
Salt
Salt


EAGLE MOUNTAIN MINE PROJECT
Coxcomb Mountain 15' USGS quadrangle
NO areas of paleontologic sensitivity
NATIONAL MONUMENT
BASIN
COXCOMB MOUNTAINS
EAGLE MOUNTAINS
CHUCKWALLA
Pinto Wash
Pinto Wells
EAGLE MOUNTAIN MINE
Eagle Mountain
COLORADO RIVER AQUEDUCT
Siphon
Drill Holes
Gravel Pits
Landing Strip
Tailings Pond
Sewage Disposal
Substation
Pumping Plant
Surge Tank
Victory Pass
Big Wash
Gaging Station
Gravel Pit
Well
Reservoir
Corona
JEEP TRAIL

EAGLE MOUNTAIN MINE PROJECT
Chuckawalla Mountains 15' USGS quadrangle
areas of paleontologic sensitivity
CHUCKWALLA VALLEY
Desert Center
PIPELINE
LANDING FIELD
FENCE
Pumping Sta
Corn Springs Wash
Red Cloud Wash
Lost Pony Mine
Aztec Wells
Corn Spring
Sand Dunes


EAGLE MOUNTAIN MINE PROJECT
Hayfield 15' USGS quadrangle
areas of paleontologic sensitivity
MOUNTAINS
HAYFIELD LAKE
CHUCKWALLA VALLEY
CHUCKWALLA MOUNTAINS
Hayfield
Pumping Station
Substation
Hayfield Summit Spring
COLORADO RIVER AQUEDUCT
PIPELINE
Siphon
Red Cloud Wash
Summit
Red Canyon
Creek
Canyon Spring
RAILROAD
CHOCOLATE MOUNTAIN
NAVAL


EAGLE MOUNTAIN MINE PROJECT
Hayfield 15' USGS quadrangle
areas of paleontologic sensitivity
CHOCOLATE MOUNTAIN
AERIAL GUNNERY RANGE
CHOCOLATE MOUNTAINS
Canyon Spring
Clemens Well (Dry)
Tabaseca Tank
Summit
Salt Creek
NAVAL RESERVATION BOUNDARY
BRADSHAW ROAD
RAILROAD
MINING
(CHUCKWALLA MTS.)
(COTTONWOOD)
115°45'
115°30'
33°30'
R 12 E
R 13 E
R 14 E
T 6 S
T 7 S
(FRINK)
SCALE 1:62500
CONTOUR INTERVAL 80 FEET

Appendix M
Revised Mitigation Monitoring Program

Appendix M

Mitigation Monitoring and Reporting Program

Section 21081.6 of the California Public Resources Code requires that any public agency approving a project for which an EIR has been prepared identifying significant environmental impacts and requiring mitigation and for which, therefore, specified public findings must be made, must also adopt a mitigation monitoring and reporting program. The program shall be designed to enssure compliance of the project with adopted mitigation measures. Implementation of the mitigation monitoring and reporting program is not required as part of the present EIR/EIS. For the information of the public and the decisionmaker, however, the following table summarizes the recommended mitigation monitoring and reporting program for the Eagle Mountain Landfill Project. For detailed specifics of recommended individual mitigation measures by resource area, the reader is referred to the appropriate impact discussions (Section 4.0) within the main EIR/EIS document.

For many measures that would avoid, eliminate, or substantially reduce potential adverse impacts of the proposed project, regulation by statute assigns responsibility for implementation and requires monitoring and enforcement. Permits, formal agreements, and statutory requirements are included within this category. Such measures are subject to monitoring and reporting procedures, under regulatory authority, so that no Project-specific procedures are required. Where this is the case, the "Implementation" column in the Mitigation and Monitoring Program contains the note "Regulatory Agency" or LEA (Local Enforcement Agency).

In other cases, mitigation monitoring has been recommended that is Project-specific. In those cases, the "Implementation" column in the Mitigation and Monitoring Program contains the note "Project-Specific." The responsibility for monitoring is then explained, along with a responsible official of a public agency to whom the accomplishment of monitoring must be reported.

Appendix M
Mitigation Monitoring and Reporting Program

Impact	Mitigation Measure	Monitoring Activities	Responsible Agency
Groundwater Quality and Use (EIR/EIS Section 4.1)			
1. Potential for degradation of groundwater quality due to migration of leachate. (Considered to be unlikely)	a. *Project Design and Operational Features* -- Landfill liner system (Landfill Liner System detailed in EIR/EIS Section 2.1.5.1)	1. MRC to prepare **and submit (?)** designs and specifications for the Landfill Liner System which exceed the requirements of state[23 CCR, Chapter 15, §2540C] and federal [40 CFR 258.40(a)(b)] regulations, as part of a revised Report of Waste Discharge (ROWD) and Report of Disposal Site Information (RDSI) for review and approval by agencies. 2. RWQCB staff to incorporate liner design and specifications into the conditions of reissued Waste Discharge Requirements (WDRs). 3. Agency staff to incorporate liner design and specifications into conditions of the Solid Waste Facility Permit. 4. Agency staff to field test liner performance.	Regional Water Quality Control Board (RWQCB) and LEA
	b. *Project Design and Operational Features* -- Vadose zone monitoring system; Groundwater monitoring system (Detailed in EIR/EIS Sections 2.1.8.1, 2.1.8.2, and 2.1.8.4)	1. MRC to install a sufficient number of both upgradient and downgradient monitoring wells at appropriate locations and depths to regularly sample and analyze surface water, groundwater, and soil-pore water in the unsaturated (vadose) zone according to requirements of (Title 23, Article 5, §2595(g) and 40 CFR §258.51(a)).	Regional Water Quality Control Board (RWQCB) and LEA
	c. *Project Design and Operational Features* -- Leachate Collection and Removal System (LCRS detailed in EIR/EIS Section 2.1.5.2)	1. MRC to prepare design and specifications for a LCRS which meets or exceeds all related state and federal requirements according to standards in Subchapter 15, state regulations, as part of the ROWD and RDSI for review and approval by agencies.	RWQCB and LEA

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Mitigation Monitoring and Reporting Program

Impact	Mitigation Measure	Monitoring Activities	Responsible Agency
		2. Agency staff to incorporate leachate collection system design and specifications into the conditions of the Waste Discharge Requirements.	
		3. Agency staff to incorporate leachate collection system design and specifications into the conditions of the Solid Waste Facility Permit.	
		4. MRC to monitor and periodically test groundwater.	
	d. *Project Design and Operational Features* -- Final Cover (Detailed in EIR/EIS Section 2.1.5.4)	1. MRC to prepare design and specifications for a Final Cover, which exceeds all related state and federal requirements, as part of the ROWD and RDSI for review and approval by agencies. 2. Agency staff to incorporate final cover design and specifications into the conditions of the Waste Discharge Requirements. 3. Agency staff to incorporate final cover design and specifications into the conditions of the Solid Waste Facility Permit.	RWQCB and LEA
2. Potential for degradation of groundwater quality due to landfill gas (LFG) migration (not considered to be a significant impact).	a. *Project Design Feature* -- LFG Containment and Removal System (Detailed in EIR/EIS Section 2.1.5)	1. MRC to prepare design and specifications for liner according to standards in Subchapter 15, state regulations, as part of the ROWD and RDSI for review and approval by agencies. 2. MRC to submit design and specifications for landfill gas emission and migration control system according to standards in Subchapter 15, state regulations, as part of the ROWD and RDSI.	RWQCB and SCAB

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Mitigation Monitoring and Reporting Program

Impact	Mitigation Measure	Monitoring Activities	Responsible Agency
		3. MRC must design system to conform with South Coast Air Basin (SCAB) Rule 1150.1.	
3. Potential for degradation of groundwater quality due to landfill-support facilities contaminant release from: rail container unloading; rail container washing and storage; vehicle and equipment maintenance, and temporary storage of hazardous waste.	*a. Project Design Features* -- Hazardous waste storage areas specially designated and constructed in accordance with applicable existing regulations, and located near maintenance buildings and waste inspection areas. *b. Project Operational Features* -- Adherence to regulatory requirements governing unauthorized release of hazardous substances; rapid implementation of reporting; containment; and, potentially, removal actions. 90-day limit on hazardous waste storage; adherence to regulatory requirements for containing and monitoring hazardous substances.	1. MRC to prepare design and specifications for drainage facilities according to standards in Subchapter 15, state regulations, as part of the ROWD and RDSI for review and approval by agencies.	RWQCB and LEA
4. Potential for degradation of groundwater quality due to Townsite wastewater treatment plant discharge. (Not considered to be significant)	a. None required	1. None required	N/A

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Mitigation Monitoring and Reporting Program

Impact	Mitigation Measure	Monitoring Activities	Responsible Agency
Public Health and Safety (EIR/EIS Section 4.2)			
1. Potential for public exposure to hazardous wastes in the solid waste stream at the Project site.	a. *Project Operational Feature* -- Initiate waste stream sorting process. Inspect containers at Rail Yard I or Rail Yard II as the containers arrive by train or by truck. Inspect waste during landfilling operations.	1. MRC to establish a load check program under conditions of the Solid Waste Facility Permit.	LEA
	b. *Project Design Feature* -- Construction and monitoring of the temporary hazardous waste storage area for nonconforming materials in compliance with the requirements of 22 CCR	2. MRC shall implement a program to detect and prevent the disposal of regulated hazardous wastes, including: 1) Random inspections to ensure that incoming wastes do not contain regulated hazardous wastes; 2) Records of any inspections; 3) Training of facility personnel to recognize regulated hazardous wastes; 4) Notification of CIWMB, LEA, or EPA if a hazardous waste is discovered at the site	LEA, CIWMB, and EPA
2. Potential for generation of hazardous wastes such as waste lubricants, spent cleaning solvents, paints and coatings, and contaminated disposable parts from general and mobile equipment maintenance.	a. *Project Operational Feature* -- Manage and dispose of hazardous wastes generated through operation and maintenance of machinery and vehicles in accordance with applicable regulations. Substitute less-toxic materials, where appropriate. With the exception of emergency repair work, restrict vehicle maintenance activities to maintenance buildings or bermed, sealed concrete maintenance pads at specified locations. Locate spill containment and cleanup kits at each vehicle maintenance location.	1. Standards for safety will be established and controlled through the solid waste facility permit in conformance with the 1970 Occupational Health and Safety Act (OSHA), state Title 14 Minimum Standards for solid waste handling and disposal, and the 1977 Mine Safety and Health Administration Regulations (30 CFR 56).	LEA and DTSC
3. Potential impacts to public health and safety from migration of landfill gas	a. *Project Design Feature* -- Installation of landfill composite liner system, LFG management	1. MRC to submit design and specifications for landfill gas emission and migration control system according to standards in	RWQCB, SCAB, and LEA

Appendix M
Mitigation Monitoring and Reporting Program

Impact	Mitigation Measure	Monitoring Activities	Responsible Agency
3. Potential impacts to public health and safety from migration of landfill gas (LFG) and LFG condensate.	a. *Project Design Feature* -- Installation of landfill composite liner system, LFG management system, and LFG condensate collection system designed to capture LFG and impede LFG migration	1. MRC to submit design and specifications for landfill gas emission and migration control system according to standards in Subchapter 15, state regulations, as part of the ROWD and RDSI.	RWQCB, SCAB, and LEA
5. Potential for subsurface or surface fires at the landfill or in refuse loads during transportation. Potential for railroad right-of-way fires.	a. *Project Design Feature* -- Installation of landfill composite liner system, LFG management system to capture LFG and impede LFG migration c. *Project Operational Feature* -- MRC will operate its own emergency response plan. d. Surface/right-of-way fires would be controlled by conventional firefighting means. The Eagle Mountain Townsite fire station would add to the firefighting capability in the project vicinity.	1. MRC to submit design and specifications for landfill gas emission and migration control system according to standards in Subchapter 15, state regulations, as part of the ROWD and RDSI. 2. MRC must design system to conform with SCAB Rule 1150.1. 3. MRC to establish emergency response plan under conditions of the RDSI and reviewed by the local fire department and LEA.	RWQCB, LEA, and Fire Department
6. Potential for public health and safety impacts related to increased vectors.	a. *Project Design Features* -- Apply daily cover. Control litter. Install appropriate barriers and use explosive noises to repel birds	1. MRC to submit plans for interim daily cover according to standards in Subchapter 15, state regulations, as part of the RDSI.	RWQCB, LEA, and Fire Department
7. Potential for exposing landfill workers to accident or harm from heavy equipment operations, noise, odors, and dust.	a. *Project Operational Feature* -- Develop procedures for employees handling waste, including use of personal protective equipment, use of enclosed cabs on heavy equipment, rotation of worker assignments, and adequate supervision of personnel.	1. Standards for safety will be established and controlled through the solid waste facility permit in conformance with the 1970 Occupational Health and Safety Act (OSHA), state Title 14 Minimum Standards for solid waste handling and disposal, and the 1977 Mine Safety and Health Administration Regulations (30 CFR 56).	LEA

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Mitigation Monitoring and Reporting Program

Impact	Mitigation Measure	Monitoring Activities	Responsible Agency
Traffic and Transportation (EIR/EIS Section 4.3)			
1. No significant traffic or transportation induced impacts requiring mitigation have been identified.	a. None required.	1. None required.	N/A
Air Quality (EIR/EIS Section 4.4)			
The proposed project could result in reduced pollutant emissions in the South Coast Air Basin (SCAB) at the expense of increased emissions in the Southeast Desert Air Basin (SEDAB). Emissions reductions in the SCAB would not outweigh the impacts to the SEDAB, so that the project would have an overall significant impact on air quality. Mitigation will be required of the project as explained below, but mitigation will not reduce impacts to a level of insignificance.			
1. Site preparation and construction activities will result in the emission of pollutants and in the generation of fugitive dust.	a. *Project Design and Operational Feature* -- Construction impacts are short-term and emissions from equipment will be controlled by air quality management district rules.	1. MRC to control dust by regular watering. 2. MRC to maintain vehicles in compliance with exhaust controls stipulated by state and federal standards. Smog check program by state, periodic inspection by other agencies.	SCAQMD and LEA California Air Resources Board (CARB), Department of Motor Vehicles, and SCAQMD
2. Pollutants will be produced at transfer stations by waste loading vehicular exhaust.	a. *Project Operational Feature* -- Waste loading vehicles and equipment will be subject to applicable regulations of the CARB. No additional mitigation is available through this project.	1. MRC to maintain vehicles in compliance with exhaust controls stipulated by state and federal standards. Smog check program by	EPA and CARB

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Mitigation Monitoring and Reporting Program

Impact	Mitigation Measure	Monitoring Activities	Responsible Agency
3. Truck engines and diesel locomotive exhausts will produce emissions during transport of solid waste to the landfill.	a. *Project Operational Feature* -- Truck emission will be subject to all heavy-duty diesel engine emission standards, motor vehicle diesel fuel standards, excessive visible diesel truck smoke enforcement, emissions equipment, antitampering programs, anticipated new low emission vehicle regulations, and anticipated phase-in of low emission vehicles in fleets.	1. MRC to maintain vehicles in compliance with exhaust controls stipulated by state and federal standards. Smog check program by state, periodic inspection by other agencies.	CARB, Department of Motor Vehicles, and SCAQMD
	b. *Project Operational Feature* -- Locomotive emissions will be subject to all regulations for emissions.	1. MRC to maintain locomotives under their control in compliance with exhaust controls stipulated by state and federal standards.	CARB and SCAQMD
4. Air pollutants will be generated by the exhaust of onsite, heavy mobile and stationary equipment used in handling solid waste and materials.	a. *Project Operational Feature* -- All MRC-controlled vehicles and equipment shall comply with all applicable regulations and diesel fuel specifications as required by the CARB and the SCAQMD. Such engines and equipment shall be operated in accordance with the manufacturers' recommendations, receive regular preventive maintenance, and incorporate low NO_x emissions design whenever feasible. Equipment shall be electrified whenever feasible.	1. MRC to maintain vehicles in compliance with exhaust controls stipulated by state and federal standards.	CARB and SCAQMD

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Mitigation Monitoring and Reporting Program

Impact	Mitigation Measure	Monitoring Activities	Responsible Agency
5. Potential source of air pollution due to landfill gases. Exposure to the trace toxic air contaminants in the landfill gas (LFG) could represent a health risk.	a. *Project Design and Operational Feature* -- MRC shall install equipment for LFG control and conduct a health risk assessment in accordance with the provisions of Assembly Bill 2588 and of Proposition 65.	1. MRC to incorporate risk assessment into RDSI, for review and approval by agencies, and to perform monthly sampling of integrated surface samples for LFG with reports to agencies.	CARB, SCAQMD, and LEA
6. Handling and transfer of solid waste and cover material at the landfill site could generate excessive fugitive dust.	a. *Project Operational Feature* -- Dust generation will be controlled through compliance with the provisions of SCAQMD Rule 403.	1. MRC to control dust by paving permanent roads and by regular watering.	SCAQMD
Land Use (EIR/EIS Section 4.5)			
1. Potential for incompatibility with existing residential and correctional uses near the landfill operations.	a. *Project Design and Operational Features* -- 1) Obscure views into the working areas of the landfill by existing stockpiles and screening berms. 2) Apply calcium lignosulphanate or other comparable dust suppressant. 3) Landscape buffers between commercial and residential uses 4) Landfill trucks restricted to Eagle Mountain Road and the last 2 miles of Kaiser Road. 5) A minimum of 6 inches of daily cover would be placed over the refuse 6) Restrictions on equipment operation during nighttime hours	1. Condition of the Eagle Mountain Townsite Specific Plan.	RCPD
2. Potential for incompatibility with land uses in vicinity. (Not considered significant)	None required.	None required.	

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Mitigation Monitoring and Reporting Program

Impact	Mitigation Measure	Monitoring Activities	Responsible Agency
3. Potential for inconsistency with existing plans and policies.	a. *Project Design Features* -- The proposed Project includes two County General Plan Amendments, two Zone Changes, Development Agreement, Revised Reclamation Plan, two Specific Plans, a tentative tract map, and the BLM/Kaiser land exchange and rights-of-way.	1. Compliance with the Eagle Mountain Townsite Specific Plan.	RCPD
Surface Water Drainage and Flooding (EIR/EIS Section 4.6)			
1. Potential drainage impacts to the landfill, the Townsite, and alluvial areas to the east.	a. *Project Design and Operational features* -- All conveyance structures around the landfill will be designed to handle a 500-year storm event. After significant rainfall events, all ditches and detention ponds will be inspected and periodically cleaned out. In addition, the final landfill slope would be a minimum of 3 percent.	1. Designs incorporated into ROWD and RDSI, to the satisfaction of agencies.	RWQCB, Riverside County Flood Control District, and RCPD
Biology (EIR/EIS Section 4.7)			
1. Potential for impacts to various wildlife species.	a. *Project Design Features* -(Detailed in EIR/EIS Section 4.7.3.3)	1. *General Mitigation Measures* -(Detailed in EIR/EIS Section 4.7.3.3)	BLM CDFG NPS ACOE
	1) Land exchange of high quality habitat for desert tortoise, desert pupfish, and other plant and wildlife species to BLM	1) California 2081 management agreement for the incidental take of desert tortoise and desert pupfish;	
	2) MRC contribution to aid in establishing experimental population of Salt Creek pupfish at Deep Canyon Reserve	2) California 1603 streambed alteration agreement;	

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Mitigation Monitoring and Reporting Program

Impact	Mitigation Measure	Monitoring Activities	Responsible Agency
	3) Mitigation fee of $1.00 per ton of waste disposed to be used in an Environmental Mitigation Trust.	3) Section 7 consultation authorizing the incidental take of desert tortoises and desert pupfish;	
		4) Former Record of Decision (BLM); 5) MOU among MRC, CDFG, and NPS relative to bighorn sheep;	
		6) Memorandum from the Army Corps of Engineers (Department of the Army, 1994) indicating that the Project would be covered by nationwide Section 404 permit.	
2. Potential impacts to Special Status Plant Species -- ***Alverson's Foxtail Cactus***	***a. Specific Mitigation Measures (Detailed in EIR/EIS Section 4.7.3.3)-*** 1) Prior to ground disturbance, conduct plants/acre census and soils analyses to assess transplant compatibility. 2) Transplant individuals salvaged from the impacted areas at a density similar to that estimated for the natural population. 3) Select rail staging and storage areas based on preconstruction surveys to avoid impacts to Alverson's foxtail cactus 4) Initiate transplantation program at least one year prior to impacting the cactus population	1) Final mitigation areas would be monitored once a month for one growing season to measure survivorship and determine transplant program success. 2) A final report, summarizing the effort, would be prepared and submitted to the BLM, CDFG, and NPS.	BLM

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Mitigation Monitoring and Reporting Program

Impact	Mitigation Measure	Monitoring Activities	Responsible Agency
3. Potential impacts to Special Status Plant Species -- ***Orocopia Sage*** (Not considered significant)	a. *Specific Mitigation Measures* (Detailed in EIR/EIS Section 4.7.3.3)-- 1) Prior to construction activities, delineate specific areas to avoid and areas where unavoidable impacts can be minimized, including flagging individual shrubs for avoidance. 2) Establish maintenance and construction staging areas to avoid areas containing orocopia sage populations. Keep roads to their current widths. 3) Minimize disturbance corridor near populations of plants.	None required.	N/A
4. Potential impacts to Special Status Wildlife Species -- ***Desert Pupfish***	a. *Specific Mitigation Measures* (Detailed in EIR/EIS Section 4.7.3.3)-- 1). Monitoring program, emergency accident plan, construction design modifications.	1. Annual surveys of the pupfish populations and habitat will continue along Salt Creek and its tributary under the train trestle, by CDFG. Although no significant changes are expected, in the event there are any effects on the habitat which are caused by the train operations, these will be reported to MRC and corrective actions will be developed in consultation with USFWS and CDFG. 2. Plans for construction or major maintenance will be reviewed by a biologist and will include designs and specifications that will avoid impacts to desert pupfish, to the satisfaction of resource agencies. Storage and staging areas will be placed in locations which will not affect the habitat, and measures to avoid any discharge of pollutants will be incorporated.	CDFG and USFWS

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Mitigation Monitoring and Reporting Program

Impact	Mitigation Measure	Monitoring Activities	Responsible Agency
		3. In the event of an accident near pupfish habitat, MRC will include a biologist as a response and cleanup team member. Measures to restore the pupfish habitat in Salt Creek and its tributary in the event of an accident shall be incorporated as part of the response. If restocking of pupfish is required in the aftermath of an accident, the nearest suitable genetic strain of pupfish will be the source of the transplantation. Procedures and results will be reported to, and approved by, the resource agencies.	
5. Potential impacts to Special Status Wildlife Species -- ***Desert Tortoise***	a. *Specific Mitigation Measures* (Detailed in EIR/EIS Section 4.7.3.3)-- 1) Preoperation surveys, monitoring, raven control plan, rail and road barriers and culverts, employee education, offsite habitat preservation (375 ac).	1. A qualified biologist will perform precon-struction surveys, and will monitor the repair and replacement of all permanent structures, such as railroad tracks and culverts, within tortoise habitat. Monitoring and other mitigation activities will be in accordance with the Section 7 consultation and agreement, and will continue as deemed necessary by agencies. 2. Tortoises threatened by track rehabilitation activities will be relocated to a suitable place. The handling and removal of tortoises will be conducted by a qualified biologist approved by USFWS and BLM. 3. A system of culverts and other structures will be placed under the railbed and Eagle Mountain Road in areas to be determined by baseline tortoise surveys and decided by BLM and USFWS. The effectiveness of these crossings as passages for tortoises will be monitored concurrently with the tortoise population and raven monitoring programs.	USFWS and BLM County Department of Transportation U.S. Department of Agriculture CDFG

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Mitigation Monitoring and Reporting Program

Impact	Mitigation Measure	Monitoring Activities	Responsible Agency
		4. Protective barriers will be placed on each side of the railroad tracks and Eagle Mountain Road, in areas approved by agencies.	
		5. Habitat loss will be mitigated by the purchase of desert tortoise habitat for transfer to permanent BLM ownership. The exact parcel(s) to be purchased for compensation will be selected by BLM.	
		6. A detailed raven control plan, plus the appropriate permits, will be developed and in place before landfill operations begin. The plan will include a raven population monitoring program, a passive raven control program, and an active raven control program (raven destruction). All programs will be undertaken in conjunction with USFWS, BLM, and CDFG and with the Raven Management Plan for the California Desert Conservation Area.	
		7. A worker education program will be incorporated into the project, to the satisfaction of the resource agencies.	
6. ***Potential impacts to Special Status Wildlife Species*** -- Nelson's Bighorn Sheep	a. *Specific Mitigation Measures* (Detailed in EIR/EIS Section 4.7.3.3)	1. A 2-year monitoring study will be conducted to identify new locations to place permanent water sources, based on herd movements.	BLM and CDFG

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Mitigation Monitoring and Reporting Program

Impact	Mitigation Measure	Monitoring Activities	Responsible Agency
	a. Create and enhance offsite water sources, monitoring program, onsite habitat preservation (644 acres).	2. Three new permanent water sources will be placed far from the mine site to encourage bighorn sheep to use the surrounding natural areas. The sites for the water sources and their design will be approved by biologists at BLM and CDFG. Buzzard Springs will also be rehabilitated and cleared of tamarisk. If sheep are not found to naturally expand their ranges to incorporate the new water sources, they will be translocated.	
		3. Approximately 644 acres of bighorn sheep habitat onsite will be preserved within the open space buffer areas surrounding the landfill.	
		4. MRC will incorporate information on bighorn sheep habits and habitat needs, as well as their protected status, into their employee training program, to the satisfaction of the resource agencies.	
		5. MRC will allow only authorized individuals to possess firearms on the landfill site to preclude the possibility of poaching or harassment of bighorn sheep, to the satisfaction of the resource agencies.	
		6. MRC will prohibit dogs on the landfill site unless they are confined or restrained, to the satisfaction of the resource agencies.	
7. Other Sensitive Wildlife. Potential loss of bat roosting areas, hibernacula. Possible increased raven predation on Eagle Mountain scrub jay nestlings. Potential impacts to other sensitive species are not considered significant.	a. *Specific Mitigation Measures* (Detailed in EIR/EIS Section 4.7.3.3) b. Monitoring of bat roost sites, and maintenance of adit opening. Raven monitoring and control program.	1. MRC will monitor the California leaf-nosed bat population at the mine during landfill operations. MRC will design a chimney constructed of large-diameter concrete pipe, or similar structure, to be installed over the mine adit to permit the ingress and egress of the bats. This chimney will be extended as the level of refuse increases. Design and construction must be approved by agencies.	LEA and CDFG

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Mitigation Monitoring and Reporting Program

Impact	Mitigation Measure	Monitoring Activities	Responsible Agency
Growth Inducement and Socioeconomics (EIR/EIS Section 4.8)			
Since the proposed Project would represent a socioeconomic benefit to the community of Eagle Mountain and no adverse regional socioeconomic impact is anticipated, no mitigation measures are required. The proposed Project is not growth inducing.			
Geology (EIR/EIS Section 4.9)			
1. Potential for seismic event impacts (Not considered significant).	a. *Project Design Feature* -- 1) Design all containment facilities to withstand a magnitude 6.5 event located 5 miles from the site generating an acceleration of 0.56 g at the site. 2) Remove and replace any previous fill or loose alluvium that would provide support for any facilities with compacted fill prior to the construction of the facilities.	1. Prescriptive standards for site preparation established by SWFP/LEA and the County geologist.	LEA, RWQCB, and RCPD
2. Potentially impacts from expansive soils and slope instability. (Not considered significant).	a. Expansive soils in the alluvial material in the landfill footprint shall be regraded to reduce expansive potential to a safe level; unsuitable soils shall be excavated and recompacted.	1. Grading plans for project shall incorporate recommendations of geology and soils reports, reviewed and sponsored by agencies.	LEA, RWQCB, and RCPD
3. Full development of the landfill would prohibit continued mining in the landfill area, including extraction of iron ore from portions of the Central Pit. (Not considered significant).	a. Phase project to allow areas with potential for mineral recovery to be developed last.	1. Phasing shall be made a condition of the specific plan.	RCPD

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Mitigation Monitoring and Reporting Program

Impact	Mitigation Measure	Monitoring Activities	Responsible Agency
Visual and Recreation (EIR/EIS Section 4.10)			
1. Potential for increased visual contrast with existing landscape	a. *Project Design and Operational Feature* MRC shall: 1) Minimize landfill active area to the greatest possible extent to reduce the visual impact of landfill operations. 2) Utilize final cover materials that closely resemble the color of the surrounding natural landscape. 3) Reduce visual contrast of the final landfill's form and line by making the final contours more irregular and less even.	1. The mitigation measures shall be required as part of the Solid Waste Facility Permit and made conditions of the specific plan. Final cover conditions must be established to the satisfaction of agencies prior to acceptance of closure report.	LEA and RCPD
2. Potential for visibility impacts from windblown debris, litter, and dust	a. *Project Design and Operational Features* (Detailed in EIR/EIS Section 4.10. 1) Implement dust and litter suppression program.	If it is determined at any time that windblown litter from the landfill is having an adverse affect on JTNP, NPS and BLM and the County will be consulted to assess appropriate remedial action. Litter control measures shall be jointly evaluated and amended, as necessary by MRC, BLM, and NPS after the first 6 months of landfill operation	BLM County
3. Potential for visibility impacts from nighttime lighting	a. *Project Design and Operational Features* 1) MRC shall utilize a nonreflective material and glass for building construction and equipment to reduce glare. Lighting standards will also be implemented.	1. Condition of the Specific Plan.	LEA and RCPD

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Impact	Mitigation Measure	Monitoring Activities	Responsible Agency
	2) MRC shall provide shielded lighting directed downward at the landfill. The specific lighting requirements will vary, depending on the size and shape of the area, mounting height of the lighting, and illumination requirements for the different site operations.		
4. Potential for impacts to recreational resources. (Not considered significant)	None required.	None required.	N/A
Wilderness (EIR/EIS Section 4.11)			
1. Potential for aesthetic impacts from: (1) Nighttime Lighting; (2) Visual Resources; (3) Visibility; (4) Windblown Debris; (5) Noise; and (6) Odor. (Not considered significant)	a. *Project Design and Operational Features* -- (Detailed in EIR/EIS Section 4.11. 3.2 and Section 4.10 mitigations above) None required.	None required.	N/A
Utilities and Services (EIR/EIS Section 4.12)			
1. Potential for impacts to water and sewer services; fire, police, and emergency services; utility infrastructure; and community services. (Not considered significant)	None required.	None required.	N/A
Noise (EIR/EIS Section 4.13)			
No significant cultural resource site was identified that would be affected by the proposed Project. No potential impact on native American concerns was identified. No mitigation is required.			
Cultural Resources (EIR/EIS Section 4.14)			
1. Potential impacts to cultural resources due Project-related excavation. (Not considered significant)	a. None required.	1. None required.	N/A

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Mitigation Monitoring and Reporting Program

Impact	Mitigation Measure	Monitoring Activities	Responsible Agency
Paleontology(EIR/EIS Section 4.15)			
1. Potential impacts to paleontological resources due to excavation involving improvements to Eagle Mountain Road and the Interstate 10 interchange.	a. Paleontological monitoring program.	1. MRC will retain a qualified paleontologist to conduct a pre-excavation survey, monitor excavation activities, recover and curate fossils, and to prepare and submit a report of findings, to be reviewed and approved by agencies.	BLM and RCPD
Energy Consumption/Generation(EIR/EIS Section 4.16)			
1. Potential for energy (fuel, electricity, natural gas) consumption impacts.(Not considered significant).	a. None required.	1. No monitoring beyond that required for air quality mitigation.	California Air Resources Board (CARB), Department of Motor Vehicles, and SCAQMD
	b. Install energy recovery system for LFG disposal, when feasible.	1. MRC will conduct cost-effectiveness study at time additional pollution control equipment is required on LFG flares, for review and approval by agencies.	RCPD and SCAQMD